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RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT
ADDENDUM FOR ZONE I AND U S NAVY RESPONSES TO SOUTH CAROLINA
DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL COMMENTS CNC
CHARLESTON SC
9/5/2001
CH2M HILL

RFI REPORT ADDENDUM

Zone I RFI Report Addendum and Responses to SCDHEC Comments



***Charleston Naval Complex
North Charleston, South Carolina***

SUBMITTED TO
***U.S. Navy Southern Division
Naval Facilities Engineering Command***

CH2M-Jones

August 2001

***Revision 0
Contract N62467-99-C-0960***



September 5, 2001

CH2M HILL

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Mr. David Scaturo
Division of Hazardous and Infectious Wastes
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: RFI Report Addendum – Zone I

Dear Mr. Scaturo:

Enclosed please find four copies of the RFI Report Addendum for Zone I of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

This submittal is divided into the following three sections:

1. The first section contains CH2M-Jones' responses to SCDHEC comments concerning the *Zone I RFI Report, Revision 0* (EnSafe, 1997).
2. The second section contains replacement pages, per CH2M-Jones' responses to comments, which are to be replaced according to page number in the *Zone I RFI Report, Revision 0*. Each page itemized in the Table of Contents for this report shows the changes that were made, and are represented by the blue page[s]. The white pages immediately following are the actual replacement pages, which have have been 3-hole drilled for your convenience.
3. The third section of this report contains material that is referenced in CH2M-Jones' response to SCDHEC comments.

The principal author of this document is Kris Garcia. Please contact her at 770/604-9182, extension 476, if you have any questions or comments.

Page 2
September 5, 2001

Sincerely,

CH2M HILL

A handwritten signature in black ink, appearing to read "Dean Williamson". The signature is fluid and cursive, with the first name "Dean" and last name "Williamson" clearly distinguishable.

Dean Williamson, P.E.

cc: Rob Harrell/Navy, w/att
Gary Foster/CH2M HILL, w/att
General Distribution

RFI REPORT ADDENDUM

Zone I RFI Report Addendum and Responses to SCDHEC Comments



***Charleston Naval Complex
North Charleston, South Carolina***

**SUBMITTED TO
*U.S. Navy Southern Division
Naval Facilities Engineering Command***

**PREPARED BY
*CH2M-Jones***

August 2001

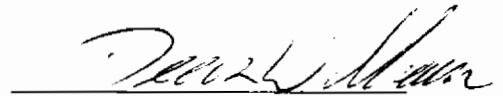
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Contract N62467-99-C-0960
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Certification Page for the Zone I RFI Report Addendum and Responses to SCDHEC Comments

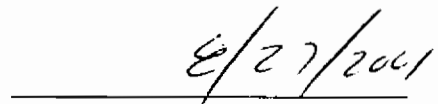
I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

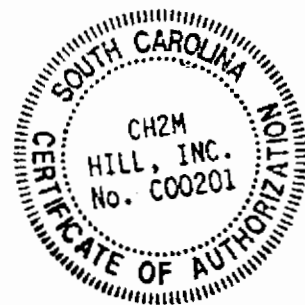
Temporary Permit No. T2000342



Dean Williamson, P.E.



Date



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APPENDICES

- A1** *Initial Assessment Study, Naval Base Charleston (ESE, 1981)*
- A2** *Confirmation Study: Assessment of Potential Oil and Hazardous Waste Contamination of Soil and Groundwater at the Charleston Naval Shipyard (Geraghty & Miller, 1982)*
- A3** Naval Base Charleston Environmental Cleanup Project Team Meeting Minutes (August 24 – 25, 1999)
- B** AOC 679 Historical Record (1942 - 1944) Drawings; AOC 678 Firefighter Training Mock-up Areas
- C** Underground Storage Tank Investigation Correspondence and Assessment Report (Buildings NS-1 & NS-26)
- D** Underground Storage Tank Assessment Report (Building 681)

Responses to SCDHEC Comments

Comment

1. Iron as a Ecological and Human Health Chemical of Potential Concern, Sections 7 and 8.

The Navy did not assess iron as a COPC (human health or ecological) based on their belief that it is a naturally occurring nutrient.

Please note the following: Supplemental Guidance to RAGS, Region IV Bulletins lists nutrients that can be excluded from consideration as a COPC in Risk Assessments. Only calcium, chloride, iodine, magnesium, phosphorus, potassium, and sodium are listed as compounds that may be eliminated but must be evaluated if detected at levels that may pose a risk to human health or the environment. Iron is no longer listed as an essential nutrient and should therefore be evaluated throughout the Human Health and Ecological Risk Assessments.

EPA Region IV's Ecological Screening Value for iron in soil is 200 mg/kg and a RBC value has been established at 2.3×10^4 . Since the iron values detected at CNC are elevated, it would not be appropriate to eliminate iron as a COPC or ECPC from the investigation.

Region IV Ecological Screening Values are derived from the December 22, 1998 Memorandum from Ted Simon of EPA regarding Ecological Risk Assessments at Military Bases.

Please revise sections 7 and 8 to include iron as a COPC.

EnSafe/Navy Response 1:

The Navy agrees that it is no longer appropriate to simply eliminate iron as a potential COPC or ECPC solely on the basis that it is an essential nutrient. This same comment is currently being addressed with respect to the Zone F, G, and K RFI reports in addition to Zone I. EnSafe is in the process of developing a background value for iron to be used as a tool along with risk based screening levels in the COPC selection process. EnSafe intends to have the proposed background values available for review and comment by 30 June 1999. At sites where iron is identified as a COPC because it exceeds the screening values it is going to be difficult to determine its significance in the risk assessment process because it is an essential nutrient. Rather than attempt to develop a framework for managing those sites in this draft response to comment document the Navy and EnSafe simply propose that the appropriate risk assessment personnel be made available to discuss this matter and document the outcome of the discussion in the final response to comments which will be submitted with the revised document.

CH2M-Jones Response 1:

A background value of 2 times the mean iron value was calculated and presented as part of a technical memorandum titled A Summary of Inorganic Chemical Concentrations in Background Soil and Groundwater at CNC, August 2001, prepared by CH2M-Jones. Any iron values exceeding background concentration ranges within Zone I and the main installation will be addressed to assess potential human health risks and/or offsite runoff to water bodies that are of ecological significance (i.e., Shipyard Creek, Cooper River).

Comment

2. SWMU 12.

A review of aerial photographs and analytical results causes the Department to question whether the Fire Fighting Area existed in the area noted as SWMU 12. The Department will continue to investigate this and may require the Navy to conduct an investigation on the area the Department believes may have been the Fire Fighting Area. This concern does not alter the decision that an RFI for groundwater is required for "SWMU 12."

EnSafe/Navy Response 2:

On 17 May 1999 an e-mail was sent out to members of the Project Team which described an approach further investigate the area the Department believes may have been the Fire Fighting Area. The e-mail was followed up with an aerial photo showing the suspected area and the proposed hand auger locations. EnSafe used a hand auger to visually inspect the soil to a depth of 4 feet at the proposed locations and subsequently expanded the search when nothing out of the ordinary was found. In addition to the visual inspection a PID was used to screen for organic vapors and none were noted. Attachment B contains an aerial photo of the search area. The Navy and EnSafe do not have any additional field work planned pending a Project Team review and discussion of the recent investigative efforts.

CH2M-Jones Response 2:

CH2M-Jones concurs with the response provided by EnSafe/Navy. However, SCDHEC has since provided an additional undated aerial photograph that shows a historical surface feature further northwest, along the same road, and has questioned whether the correct location was originally investigated for SWMU 12. Based on review of the existing database, it appears that sampling may have already been conducted in this area.

Based on research conducted in response to this comment and by obtaining the geographic coordinates relative to known features, CH2M-Jones has concluded that the feature in the vicinity of SWMU 12, cited by SCDHEC from an undated aerial photograph, does not warrant further investigation or evaluation. The area was initially investigated by a team from Environmental Science and Engineering in 1981 during the Initial Assessment Study (see Appendix A1). The field investigation did not turn up any evidence of residue from the pit. Geraghty and Miller also conducted an assessment for a confirmation study in 1982, again finding no evidence of concern in the subsurface soils or petroleum-related plumes, even though the Geraghty and Miller investigation specifically looked for potential soil and groundwater impacts (see Appendix A2).

At SCDHEC's request, EnSafe conducted the third investigation of the area in May 1999, again with negative results. The EnSafe field investigation and evaluation also appears to have adequately addressed the potential presence of residual features. In addition, SCDHEC appears to have concurred that no further investigation is necessary during the August 24-25, 1999, meeting of the Environmental Project Team, which included representatives of SCDHEC, South DIV, EPA, EnSafe, and CLD, and as documented in the minutes from this meeting. Documentation for these investigations is attached (see Appendix A3).

Further assessment of this issue is not warranted.

Note: Attachment B was previously submitted to SCDHEC by EnSafe/Navy in their June 25, 1999 Draft Response to SCDHEC Zone I RFI Report Comments. It is not included in this response to comments.

Comment

1. AOC 675/676/677.

The Navy, in the Response, states that "this area is already being addressed by the tank program." The Department contacted Paul Bristol of the Tank Program who explained he reviewed a closure report for "NS-2A" and "NS-4". The Department agrees that the Tank Program is the most appropriate program to address environmental concerns at AOC 675/676/677. However, the Navy must submit to the Department a request to transfer AOCs 675/676/677 from RCRA Subtitle C to RCRA Subtitle I authority.

Upon reading Mr. Bristol's correspondence with the Navy, the Department realizes there has been a break in communications. No investigative work has been completed since the issuance of the letters in October, 1996 and March 1997. Please contact Paul Bristol at (803) 898-3559 to resume this work.

EnSafe/Navy Response 1:

The Navy intends to submit a request to transfer AOCs 675/676/677 from RCRA Subtitle C to RCRA Subtitle I authority and complete the corrective action work under that program.

CH2M-Jones Response 1:

The Navy still intends to complete this transfer. CH2M-Jones will provide follow-up documentation separately.

Comment

2. Page 10.4.1 AOC 678/679.

The addendum to the revised RFI Report was not available for review. This information must be provided before the Department can complete the review of this work.

EnSafe/Navy Response 2:

An addendum for AOCs 678, 679, and 680 has been prepared by EnSafe and it is currently being reviewed by the Navy prior to submittal to the remainder of the Project Team.

CH2M-Jones Response 2:

EnSafe/Navy submitted the necessary documentation for AOCs 678/679 on June 30, 1999, as an addendum to the Final RFI Report for Zone I. SCDHEC reviewed this submittal on December 14, 1999. Response to comments generated by SCDHEC based on their review of the AOC 678/679 report are included with this submittal.

Comment

3. Page 10.5.1 AOC 680. See Comment 2.

EnSafe/Navy Response 3:

Please refer to the response to [Michael Danielsen's] Comment #2 [on the Navy's May 7, 1999 submittal].

CH2M-Jones Response 3:

EnSafe/Navy submitted the necessary documentation for AOC 680 on June 30, 1999 as an

addendum to the Final RFI Report for Zone I. SCDHEC reviewed this submittal on December 14, 1999. Response to comments generated by SCDHEC based on their review of the AOC 680 report are included with this submittal.

Comment

4. Page 10.6.1 AOC 681. See Comment #2.

EnSafe/Navy Response 4:

An update of the status of AOC 681 was provided at the February 1999 Project Team meeting (please refer to discussion item 9902-M385 in the minutes) at which time the team discussed the need for additional soil samples to determine if the detected petroleum contamination extended underneath Building 681. The Detachment recently completed the sampling effort and has prepared a brief report describing the results. This report is included as Attachment C to this response document so that team members can review the most recent information and reach a consensus agreement on what the next step should be for this site.

CH2M-Jones Response 4:

EnSafe/Navy submitted the necessary documentation for AOC 681 on July 30, 1999 as an addendum to the Final RFI Report for Zone I. SCDHEC reviewed this submittal on December 14, 1999. Response to comments generated by SCDHEC based on their review of the AOC 680 report are included with this submittal.

Note: Attachment C was previously submitted to SCDHEC by EnSafe/Navy in their June 25, 1999 Draft Response to SCDHEC Zone I RFI Report Comments. It is not included in this response to comments.

Comment

5. Well 687GW002 is a permanent well that has been sampled 6 times from 1995 to 1998. The maximum contaminant level (MCL) for Arsenic is 50 ug/L. Arsenic concentrations have exceeded the MCL in 3 rounds of sampling. The levels were: 73.7 ug/L (round 2), 131 ug/L (round 5), and 58.3 ug/L (round 6). It is clear that these hits are not random and indicates that contamination exists.

Contamination cannot be delineated from a single monitoring well (arsenic does not exceed its MCL in the other three wells at AOC 687 (687GW001, 003, and 004). The Navy must delineate the horizontal and vertical extent of arsenic contamination in groundwater. If the Navy believes the detection of arsenic is site related or is the result of a naturally occurring geologic condition, the Department is amenable to reviewing additional information that substantiates that claim.

EnSafe/Navy Response 5:

The Navy recently submitted a technical memo documenting the results of a study on the use of low flow sampling methods for the collection of groundwater samples intended for metals analysis. The results of this study preliminarily indicated that groundwater samples collected for metals analysis at various sites across the base may have contained false positives as a result of pumping rates that exceeded the recharge rate of the shallow aquifer. Pumping rates which exceed the recharge rate of the aquifer can increase turbidity and/or mobilize particles that would ordinarily be immobile under natural groundwater flow conditions. In May 1999, another round of

groundwater samples were collected from the monitoring wells at AOC 687. During this sampling event a low flow method was used. Arsenic concentrations in monitoring well #2 decreased rather significantly to levels below the MCL. The Navy proposes to collect another round of groundwater samples from this site in August 1999 using the low flow approach. If the results are less than the MCL the Navy recommends no further action for this site. If the concentration at well #2 exceeds the MCL additional monitoring may be required but the Navy disagrees with the need for additional delineation. The wells at which arsenic does not exceed the MCL are part of the effort to delineate the extent of arsenic found in well #2. The fact that well #2 was the only well where arsenic was detected above the MCL indicates that it is a localized occurrence and there is nothing further to delineate. A summation of the arsenic data for the groundwater samples collected from AOC 687 is presented below. Attachment D contains a copy of a portion of the potentiometric surface map from the RFI report which may also be helpful while interpreting the analytical results.

Monitoring Well	Arsenic Concentration (µg/L)						
	6/95	1/96	6/96	9/96	4/98	8/98	5/99*
687-001	38.6	<5	<5	<2.5	<3.3	3.3	3.3
687-002	33.2	73.7	<5	39.3	131	58.3	26.7
687-003	<3.2	<5	5.6	<4.6	4.1	4.3	<3.3
687-004	6.3	<5	<5	<2.5	8.2	3.3	4.2
	5/95	12/95	5/96	8/96	4/98	8/98	5/99*
GDI-008	36	<5	<5	<2.5	9	6.5	3.4
GDI-08D	<3.2	<5	<5	<3.4	<3.3	<0.9	<3.3

Notes:

* Denotes low flow sampling event.

CH2M-Jones Response 5:

Based on the information provided by EnSafe/Navy, CH2M-Jones concurs that arsenic is adequately delineated at this unit. No further investigation is necessary. However, the future status of this unit will be addressed, in consultation with SCDHEC, as part of the CMS phase.

Note: Attachment D was previously submitted to SCDHEC by EnSafe/Navy in their June 25, 1999 Draft Response to SCDHEC Zone I RFI Report Comments. It is not included in this response to comments.

Comment

6. SWMU 12. Well 012002 is a permanent well that has been sampled 4 times from 1995 to 1998. The maximum contaminant level (MCL) for Arsenic is 50 ug/L. Arsenic concentrations have exceeded the MCL in all 4 rounds of sampling. The levels were: 177

ug/L (round 1), 220 ug/L (round 2), 188 ug/L (round 3), and 253 (round 4). It is clear that these hits are not random and indicates that contamination exists.

Contamination cannot be delineated from a single monitoring well (arsenic does not exceed MCLs in the other three wells at SWMU 12 (012001, 012003, GD1003 and GD103D). The Navy must delineate the horizontal and vertical extent of arsenic contamination in ground water. If the Navy believes the detection of arsenic is site related or is the result of a naturally occurring geologic condition, the Department is amenable to reviewing additional information that substantiates that claim.

EnSafe/Navy Response 6:

Two rounds of samples have been collected from SWMU 12 since the submittal of the RFI report to address the concerns described in the response to [Michael Danielsen's] Comment #5 [on the Navy's May 7, 1999 submittal]. Mixed results were achieved since results from the first round of low flow samples did not exceed the MCL whereas the results from the second round did exceed the MCL. Additional monitoring may be required at this site but the Navy disagrees that additional investigation is needed to define the extent. The entire network of monitoring wells at this site was used to define the extent of arsenic and the fact that it was only found in one well indicates that it is isolated, not that the extent hasn't been defined. A summation of the arsenic data for the groundwater samples collected from AOC 687 is presented below. Attachment C contains a copy of a portion of the potentiometric surface map from the RFI report which may also be helpful while interpreting the analytical results.

Monitoring Well	Arsenic Concentration (µg/L)					
	6/95	1/96	5/96	9/96	1/99*	5/99*
012-001	<3.2	<5	<5	<7.8	NS	<3.3
012-002	177	220	188	253	40.7	128
012-003	<3.2	<5	<5	<4	NS	<3.3
	4/95	12/95	5/96	8/96	1/99*	5/99*
GDI-003	<3.2	<5	2.9	4.9	NS	<3.3
GDI-03D	<3.2	<5	<5	3.3	NS	<3.3

Notes

* -Denotes low flow sampling event.

NS- Not Sampled

CH2M-Jones Response 6:

Based on the information provided by EnSafe/Navy, CH2M-Jones concurs that arsenic is adequately delineated at this unit. No further investigation is necessary.

Comment

1. Section 7, Page 7.10, Line 7 and Page 7.14, Line 17.

The text lists iron as one of the essential nutrients that will be eliminated from the human health risk assessment. EPA Region IV Human Health Risk Assessment Bulletin Number 2 (Data Collection and Evaluation) lists essential nutrients that may be eliminated. Iron is not listed as an essential nutrient that may be eliminated; therefore, its risk due to environmental exposure should be evaluated when necessary.

EnSafe/Navy Response 1:

Please refer to the response to [Susan Peterson's] Comment #1 [on the Navy's May 7, 1999 submittal].

CH2M-Jones Response 1:

Please refer to the response to Susan Peterson's Comment 1 in the May 7, 1999 submittal.

Comment

2. Section 10.3.6, Tables 10.3.10 and 10.3.11.

The tables list the organic and inorganic results for sediment samples collected at AOCs 675/676/677. Since no background sediment samples were collected at this site, screening values or RBCs should be listed in the table for comparison to the levels detected.

EnSafe/Navy Response 2:

Revised tables containing RBCs and background reference values will be submitted as errata pages to replace the current table. This comment will not affect the outcome of this site because, since this area is only intermittently submerged, the sediment data was included in risk screening process as if it were a surface soil. This was the reason for the reference on page 10.3.48 which stated that the data were included in table 10.3.4 which is where the initial comparison to RBCs and background is made.

CH2M-Jones Response 2:

CH2M-Jones concurs with the response provided by EnSafe/Navy. The following have been provided:

- *Revised tables (pages 10.3.48 and 10.3.49) containing RBCs and background reference values for AOCs 675, 676, and 677*

Comment

3. Section 10.7.6.3, Page 10.7.87, Line 15. The text states that "Groundwater is not currently used the future as potable or process water, nor is such use anticipated in the future." It appears that the text contains a typographical error and the words "the future" should be deleted from the text.

EnSafe/Navy Response 3:

The words "the future" will be deleted from the text.

CH2M-Jones Response 3:

CH2M-Jones concurs with the response provided by EnSafe/Navy. The following has been provided:

- *A replacement page (page 10.7.87) eliminating the words "the future."*

Comment

4. Table 10.9.18, Page 10.9.47.

The table used the abbreviation ERR; however, no description of the meaning was given in the notes or abbreviation/acronyms listing in the front of Volume I. The notes portion of the table should be modified to include the meaning of ERR.

EnSafe/Navy Response 4:

The term ERR is a default that appears in Quattro Pro tables when the cell width is inadequate for the value placed in the cell. The table will be corrected and submitted as an errata page.

CH2M-Jones Response 4:

CH2M-Jones concurs with the response provided by EnSafe/Navy. The following has been provided:

- *A replacement page for Table 10.9.18 (page 10.9.47) eliminating the abbreviation ERR.*

Comment

5. Section 10.2, Page 10.12.1, Line 10.

A typographic error is present. "Rhe" should be changed to "the".

EnSafe/Navy Response 5:

The typographic error will be corrected and an errata page submitted.

CH2M-Jones Response 5:

CH2M-Jones concurs with the response provided by EnSafe/Navy. The following has been provided:

- *A replacement page (page 10.12.1) correcting the mistyped word "the."*

Comment

6. Page 12, Response 37, SCDHEC Comments on Risk Assessment Portion of Zone I.

The response states that chemical concentrations were not compared to RBCs or reference values in the DMA area because the soils are recently dredged river-bottom sediments. In order to appropriately use the information provided regarding compounds detected in the DMA "soils", a reference value is needed. A comparable background value from another area that received river-bottom sediments (up gradient of potential CNC influence) may need to be collected. From a risk perspective, the river-bottom sediments should be compared to RBCs if the target population would come into contact with sediments in the same manner as surface soils. A common scenario is when intermittent stream sediments are treated as surface soils during times of drought when the sediments are exposed.

EnSafe/Navy Response 6:

The response to [Michael Danielsen's] Comment #37 [on the Navy's June 30, 1999 submittal.] will be revised since to state that the chemical concentrations were not compared to RBCs or reference values due to error that was made during preparation of the draft report. The error was corrected exactly as suggested in comment #6 above.

This was documented in the response to comment #38 which immediately followed the response in question.

CH2M-Jones Response 6:

CH2M-Jones concurs with the response provided by EnSafe/Navy and that adequate documentation has been provided previously. No action is necessary.

Comment

1. Sample locations on Figure 10.4.1, AOCs 678/679.

No samples were collected west of the former firefighter school. Without this information, questions of potential contamination arise. Especially since this is the area of the wash rack. Please collect samples to meet the objective of the RFI.

EnSafe/Navy Response 1:

The facility identified on Figure 10.4.1 as the "Former Firefighter School" is presumed to be a building used for administrative, classroom, and equipment storage type purposes since the mock ups where the actual training occurred are clearly identified on the historic maps. Figure 10.4.1 erroneously shows a mock up to the northwest of the school which the Navy assumes is the primary basis for this comment. The wash rack has been addressed by monitoring well 679-001 which is located on the downgradient side of where the wash rack was located.

CH2M-Jones Response 1:

CH2M-Jones concurs with the response provided by EnSafe/Navy. No additional action is necessary to respond to this comment.

Comment

2. Figures, AOCs 678/679.

Figures 10.4.2 through 10.4.8 show Zone I exceedances for Beta-BHC, Chromium, Lead, Mercury, BEQs, Benzo(a)anthracene, and Fluoranthene in that order. Upon review of Table 10.4.11 it appears that Phorate and Isodrin also exceeded residential RBC values. Please create Figures to show those exceedances. The Navy's recommendation of CMS is based on Isodrin.

This addendum contains no figures (for any of the contaminants that exceeded the criteria) that delineate the area of contamination for media. The Department is unable to issue a decision until this information is provided.

EnSafe/Navy Response 2:

The report will be revised to include a figure(s) showing the locations where phorate and isodrin were detected. Figures which delineate the extent of contamination for the various contaminants of potential concern (COPCs) will be provided in the revised report. The figures will be consistent with the example set of figures that was prepared during the resolution of comments on the Zone F, G, and K RFI reports.

As a reminder, the Navy would like to point out that additional groundwater sampling was performed at SWMU 12 and AOC 687 in response to SCDHEC comments dated May 7, 1999. The groundwater data for these sites will also be presented graphically in the new format. The May 1999 letter provided conditional approval of the recommendations for a number of sites that were discussed in the March 1, 1999 version of the Zone I RFI Report. In June 1999, the Navy submitted a response to the May 1999 comments and a meeting was held on June 30, 1999 to discuss the responses. These particular responses pointed out the fact that, even though a number of sites were preliminarily recommended for CMS (the

recommendations that were conditionally approved), these recommendations were to be discussed by the Project Team with the final recommendations being based on risk management decisions made by the Project Team. This has resulted in the creation of a new section entitled "COC Refinement" which will appear in all of the RFI reports currently under revision. The Navy does not intend to revise all of the nature and extent figures for the sites that were conditionally approved in the May 1999 letter; however, at sites where the final recommendations differ from the earlier recommendations, new figures may be required as part of the supporting documentation to justify the change.

CH2M-Jones Response 2:

- CH2M-Jones initially intended to provide revised text replacement pages to include figures showing the locations where phorate and isodrin were detected. However, CH2M-Jones' re-evaluation of the risk assessment concluded that isodrin and phorate in soils do not present excessive risks under the unrestricted land use scenario. Phorate was not retained as a COC for AOC 681 in the Zone I RFI Report, Revision 0.

In addition, there are no SSLs or risk-based criteria for isodrin, so the Zone I RFI Report, Revision 0, characterized isodrin as a COC by using aldrin as a surrogate (residential RBC=38 µg/kg). This is a very conservative approach, given that aldrin is a known carcinogen, but isodrin has not been classified as a carcinogen. Considering that isodrin is an organo-chlorine pesticide, it would have been appropriate to use another cyclodiene pesticide, such as endrin or dieldrin (residential RBCs=23,000 µg/kg and 40 µg/kg, respectively) as the surrogate. Preliminary toxicity studies did not indicate isodrin as a carcinogen, suggesting that the use of an endrin-based RBC value is more applicable. Isodrin was detected in two of the 22 samples at concentrations near 1 part per million (ppm); the remaining 20 samples were below detection limits (non-detects). Isodrin has been discontinued for use along with other OC pesticides, thus concentrations are not likely to increase. This issue will be more fully evaluated and discussed in the CMS phase of the RCRA closeout process. Therefore, no additional figures are provided for these two constituents.

- CH2M-Jones initially agreed to present graphical groundwater data for these sites. Shallow groundwater in areas adjacent to the Cooper River are strongly influenced by tidal fluctuations and the shallow groundwater discharges to the Cooper River. Zone-wide potentiometric conditions were documented in CH2M-Jones' February 2001 submittal to SCDHEC: Interim Measures Report for Groundwater Monitoring Fiscal Year 2000. This should adequately respond to the comment.
- Replacement pages (pages 10.3.101-101a and 10.4.82a) have been provided. These revised pages include a new section titled "COC Refinement."

Comment

3. Tables, AOCs 678/679, Per Table 10.4.11, Benzo(a)pyrene (not Benzo(a)anthracene) exceeded residential RBCs. If this was an oversight, please create the required figure(s) for Benzo(a)pyrene.

EnSafe/Navy Response 3:

The benzo(a)pyrene distribution is reflected in Figure 10.4.6 which illustrates the extent of the carcinogenic PAHs expressed as benzo(a)pyrene equivalents (BEQs).

CH2M-Jones Response 3:

CH2M-Jones intended to provide a revised Figure 10.4.6. However, based on completion of a comparative review of the BEQ values generated for the Zone I RFI Report, Revision 0, it was found that CH2M-Jones' recalculated values were very similar to the values generated for the Zone I RFI Report, Revision 0. Any differences were explainable by the number of significant digits and rounding used in producing the BEQ values. Therefore, it was not necessary to recalculate the BEQ values originally generated for the Zone I RFI Report, Revision 0. As a result, no replacement text or revised figures or tables are necessary for the BEQs associated with AOC 678 and AOC 679.

Comment

4. Site visit requested, AOCs 678/679. Michael Danielsen and I briefly visited these AOCs in October 1999. We had difficulty verifying the location of the soil samples (soil borings). According to the data packages, soil samples were collected in 1995. Please state the approximate year this site was paved. The Department would like to revisit these AOCs (with someone from Navy or Ensafe that would be able to answer our questions) prior to issuing decisions.

EnSafe/Navy Response 4:

The Navy does not understand what relevance re-paving of the site has to the RFI. The location of every sample point was surveyed and, if it became necessary for some reason, the Navy could re-establish the physical location of each point. The Navy would be more than willing to accompany Department personnel on a site visit to answer questions.

CH2M-Jones Response 4:

CH2M-Jones concurs with the response provided by EnSafe/Navy. A site visit can be conducted during a future BCT meeting if necessary.

Comment

5. Question on sampling dates, AOCs 678/679.

On page 26 of the data package for AOC 678 soils, the sample extraction date was 2/24/94, the sample analysis date was 2/24/95, and the sample (collection) date was 2/22/95. Please explain what extraction means (if I had not seen a separate entry for sample date I would have assumed it was the day you collected the sample) and please explain the discrepancy in dates (1994 vs. 1995).

EnSafe/Navy Response 5:

Extraction is a term referring to when the sample is prepared for analysis at the laboratory following a prescribed protocol which is part of the analytical method. The 1995 date is a typo and should be 2/22/94.

CH2M-Jones Response 5:

CH2M-Jones concurs with the response provided by EnSafe/Navy. No action is necessary.

Comment

6. Figures. Any constituent that exceeded its respective screening criteria is a COPC. No figures are included (AOC 678/679) that delineate the area of contamination for media. The Department is unable to issue a decision until this information is provided. Please provide appropriate maps and figures to illustrate the nature and extent of contamination with respect to each media (as discussed in recent team meetings). If these figures are absent from AOCs 680 and 681, please provide them for those sections also.

EnSafe/Navy Response 6:

Please refer to the response to [Susan Peterson's] Comment #2 [on the Navy's June 30, 1999 submittal] which acknowledges the Navy's intent to revise the maps.

CH2M-Jones Response 6:

CH2M-Jones initially believed that the isodrin and phorate were COCs based on the information presented in the Zone I RFI Report, Revision 0. However, a review of the RFI data, consistent with existing agreements and criteria established between CH2M-Jones and SCDHEC, shows that these constituents are not COCs. This issue will be fully addressed in the CMS Work Plan that will be prepared and submitted to SCDHEC for Zone I.

Comment

7. Clarification needed, AOC 680. In the Groundwater Pathways section on page 10.5.57, CNC states the "exposure to groundwater onsite was evaluated under both residential and site worker scenarios." And that "the ingestion and inhalation exposure pathways were evaluated assuming the site groundwater will be used for potable and/or domestic purposes and that an unfiltered well drawing from the corresponding water bearing zone, will be installed." However, on page 10.5.2 CNC states that "potential receptors, include future site workers who may be involved in invasive activity that might bring them in direct contact with subsurface contaminants." Explain why there was no mention of the future resident on page 10.5.2.

EnSafe/Navy Response 7:

This was an oversight that will be corrected in the revised report. The hypothetical site resident scenario was evaluated in the human health risk assessment for this site.

CH2M-Jones Response 7:

CH2M-Jones concurs and has taken the following action:

- *Replacement pages (pages 10.5.1 and 10.5.2) have been provided to include the "hypothetical future resident" as a potential receptor.*

Comment

8. Additional surface soil samples. CNC states that the Charleston Detachment "was tasked with collecting additional surface soil samples adjacent to and inside Building 681." This was "in addition to the samples collected as part of the RFI effort." Please explain the purpose of the samples, how were they incorporated in the RFI report, if at all.

EnSafe/Navy Response 8:

The purpose of the samples was to determine if petroleum hydrocarbon contamination extended underneath Building 681. The results were included in

Appendix I of the RFI report but they were not formally incorporated into the RFI because they were not received in time. The report will be revised to incorporate this information into the nature and extent discussion.

CH2M-Jones Response 8:

CH2M-Jones concurs with the response provided by EnSafe/Navy and has taken the following action:

- *A replacement page (page 10.6.28) has been provided that includes the data generated from the sampling conducted by the Environmental Detachment Charleston.*

Comment

9. SVOCs (PAHs) were high at 681SB009. The total BEQs were 3445 µg/kg. For that reason "the Charleston Detachment collected 6 additional samples adjacent to and/or inside Building 681 in the vicinity of boring 681SB009. Please include all data and analysis necessary to complete the RFI for this AOC. (The Navy claims that a copy of the report (by DET) was submitted. At the time of this review, the Department did not have a copy of this report. This report was not submitted along with these addendums).

EnSafe/Navy Response 9:

The data from the 6 additional samples will be incorporated into the revised report.

CH2M-Jones Response 9:

The data were originally included in the Zone I RFI Report, Revision 0 in Attachment I. However, the replacement pages (pages 10.6.29 and 10.6.29a) and a supplemental addition to Table 10.6.4 (page 10.6.27a) have been provided to include the DET BEQ values.

Comment

10. From review of analytical data, the soil boring at SB009 had many SVOC exceedances. The Department does not understand how no SVOCs were selected as COPCs. As the CNC reports on page 10.6.28 "Twenty-one SVOCs were detected in AOC 681 surface soil samples. The following PAHs exceeded their respective RBCs: benzo(a)anthracene (2,900 µg/kg), benzo(a)pyrene (2,300 µg/kg), benzo(b)fluoranthene (2,700 µg/kg), dibenzo(a,h)anthracene (407 µg/kg), and indeno(1,2,3-cd-pyrene (880 µg/kg)." Each of these exceedances occurred at boring 681SB00901. Please provide a detailed explanation for the omission of these COPCs.

EnSafe/Navy Response 10:

The only SVOCs which exceeded their respective residential RBCs were the carcinogenic PAHs. These were expressed at benzo(a)pyrene equivalents and identified as COPCs on page 10.6.56 and in Table 10.6.13. There were subsequently identified as COCs further in the risk assessment.

CH2M-Jones Response 10:

CH2M-Jones has completed a comparative review of the BEQ values generated for the Zone I RFI Report, Revision 0 and found that CH2M-Jones' recalculated values were very similar to the values generated for the Zone I RFI Report, Revision 0. Any differences were explainable by the number of significant digits and rounding used in producing the BEQ values. Therefore, it was not necessary to recalculate the BEQ values originally generated for the Zone I RFI Report,

Revision 0. As a result, no replacement text or revised figures or tables are necessary for the BEQs associated with AOC 681.

Comment

11. Page 10.6.50. The statement "the proximity of the Cooper River and the groundwater flow direction indicate that the river is a potential receptor of groundwater discharge, but attenuation along the flowpath and dilution upon discharge to the river will likely reduce concentrations of these constituents to insignificant levels" (page 10.6.50) seems more conjecture than substantiated fact. The Department expects the CNC to provide more justification to support that reasoning.

EnSafe/Navy Response 11:

This statement will either be eliminated from the revised report unless empirical data is presented as justification.

CH2M-Jones Response 11:

CH2M-Jones concurs with the response provided by EnSafe/Navy. A replacement page (page 10.6.50) has been provided to remove the reference to dilution.

Comment

12. Table 10.6.21. The acronym ND is defined in the key as "not determined." ND is well known as non-detect with regard to laboratory analysis. Please revise the key to select an alternative acronym. Apply this comment to other tables that contain this acronym in this manner.

EnSafe/Navy Response 12:

An alternative acronym will be used in the revised report.

CH2M-Jones Response 12:

The acronym is properly annotated in the tables where it appears and no further revision is necessary.

Comment

13. Unsubstantiated conclusions--Section 10.4.5.4, line 13: The CNC states that "because the site history does not include the use of potential mobilizing agents for metals, it is expected that these trends with depth represent natural variations within the site." The Department believes this statement to be illogical, given that the "there is no information regarding the type of structure that existed, operating practices or other activities conducted at these sites" as stated in Section 10.4.6.1, lines 10 and 11. If the Navy chooses to assume, it is best to assume on the side of caution.

EnSafe/Navy Response 13:

In the revised report the conclusions will be based on primarily on the observed trends in the data. It should also be pointed out that in the past the Department has been critical of the Navy for not providing an interpretation of the data. Discussing trends in the data is relatively simple, but providing an explanation for why the trends exist may require that some assumptions be made. The Navy believes that the while the assumptions should be made with caution, the caution should also be tempered by some degree of realism.

CH2M-Jones Response 13:

CH2M-Jones has provided a replacement page (page 10.4.63) to eliminate the reference to mobilizing agents.

Comment

14. SWMUs 12 and AOC 687. The Department issued some decisions on the initial Zone I RFI report AOCs and SWMUs in May, 1999. The Department determined that SWMUs 12 and AOC 687 required an RFI for groundwater. No addendum was submitted in conjunction with AOCs 678/679, 680, and 681. The Department is unable to approve the Zone I RFI report until all information is received and reviewed.

EnSafe/Navy Response 14:

Additional rounds of groundwater sampling have been performed at SWMU 12 and AOC 687 since the May 1999 letter was issued. The revised RFI report will include an updated evaluation of the groundwater at these sites.

CH2M-Jones Response 14:

Additional evaluation of the groundwater data will be conducted and replacement pages have been provided (pages 10.8.21-23, 10.8.24-27, 10.8.30, 10.11.27-32; 10.11.32a, 10.11.33, and 10.11.33a).

General Comments

Comment

1. As discussed in recent team meetings, a site specific DAF and site specific SSLs should be calculated for Zone I instead of using DAF value of 10. All detected lower interval soil samples should be compared to the site specific SSLs. COPC selection may have to be modified after the new comparisons.

EnSafe/Navy Response 1:

The identification of COPCs with the potential to leach to groundwater will be done using either the generic SSLs with a DAF of 1 or a site-specific SSL which has been determined in a manner discussed at the recent team meetings.

CH2M-Jones Response 1:

Based on the agreement between CH2M-Jones and SCDHEC (Technical Memorandum dated March 9, 2001), a DAF of 1 will be applied to VOCs for screening of subsurface metals and semivolatile COPCs. Since EnSafe used a DAF of 10, their SSL screening values are appropriate for these constituents. This re-screening will be provided as part of the CMS phase of work for Zone I.

Comment

2. No ecological issues were discussed in the addendum. Ecological risk was mentioned in the Zone I RFI; however, information regarding AOCs 679 - 681 was not available at that time. Please revise the Zone I RFI to include an ecological review of AOCs 679 - 681.

EnSafe/Navy Response 2:

The report will be revised to include a discussion of ecological risk.

CH2M-Jones Response 2:

Ecological risk is discussed overall for Zone I in Chapter 8 of the Zone I RFI Report, Revision 0, where units 679, 680, and 681 were assigned to a non-ecological area. CH2M-Jones has provided replacement pages to clarify the ecological risk standing for each of these three units (pages 10.4.1, 10.4.1a, 10.5.1, 10.5.1a, 10.6.1, and 10.6.1a).

Comment

3. As discussed in the team meetings, the maps and figures should be revised to the agreed upon format.

EnSafe/Navy Response 3:

Please refer to the response to [Susan] Peterson's Comment #2 [on the Navy's June 30, 1999 submittal].

CH2M-Jones Response 3:

SCDHEC has accepted this submittal format using replacement pages for the Zone I RFI Report, Revision 0. The current figures in the Zone I RFI Report, Revision 0 adequately convey the intended information; the creation of additional figures to accommodate a format change without adding value is not effective. CH2M-Jones did not generate new figures for the entire RFI report.

Specific Comments

Comment

1. AOC 679, Section 10.4.5.1 Soil-to-Groundwater Cross-Media Transport, Page 10.4.47, Paragraph 2. The text states that a mobilizing agent with a relatively low pH (which is not likely directly associated with site activities) would be required in order for lead and mercury to be enriched with depth. Operating practices at the site are unknown; therefore, this assumption should be deleted from the text. If the statement remains in the text, additional supporting hydrogeologic information should be included such as metals concentration over time with respect to pH and groundwater parameters from well logs.

EnSafe/Navy Response 1:

The Navy agrees with this comment and will either provide the data to support the statement or delete it if it cannot be substantiated.

CH2M-Jones Response 1:

A replacement for page 10.4.47 has been provided to eliminate the reference to mobilizing agents.

Comment

1. Page 10.4.37, Table 10.4.7, Inorganic Analytical Results for Groundwater. Selenium is listed as having a mean value of 301 µg/L after a detection of 3.1 µg/L in the fourth round. Which number is correct? The MCL for selenium is 50 µg/L. Please revise to include the correct value and recalculate any risk equations if needed.

EnSafe/Navy Response 1:

The mean concentration is erroneous and should be 3.1 µg/L. This will be corrected in the revised report. The error did not have an effect on any of the risk calculations.

CH2M-Jones Response 1:

A replacement version of Table 10.4.7 which includes the corrected value for selenium has been provided (pages 10.4.36 and 10.4.37).

Comment

2. Page 10.4.38, Table 10.4.8, Analytes Detected in Shallow Groundwater. The table shows that chlorobenzene, benzo(a)pyrene equivalents, benzo(a)anthracene were all found to be above the tap water RBC in the fifth round of sampling. Information from the table indicates that a sixth round of sampling was conducted but shows that nothing was analyzed for in the 6th round. Please clarify and revise as needed. Additional samples may be needed to complete delineation of the nature and extent.

EnSafe/Navy Response 2:

The text on page 10.4.31 provides an explanation of the various rounds of sampling. Only the well at AOC 679 was sampled during the 6th round. What is not clearly explained in the text are the reasons why only certain wells were sampled at particular times how that relates to some decision rules the Project Team agreed with respect to determining whether or not the characterization was complete. The report will be revised to clarify the various "rounds" of samples and document decisions that were reached with respect to the data.

CH2M-Jones Response 2:

A supplemental page (page 10.4.31a) has been provided to clarify the various sampling events and to explain why only the well at AOC 679 was sampled during the 6th sampling event.

Comment

3. Page 10.4.42 Inorganics in Groundwater, lines 14-15. This text is not clear as to whether groundwater analytical results were compared to the MCLs or not. Groundwater must also be compared to the MCL tables first and if an entry is not listed, then the RBC tables can be used. Please clarify if the results were compared to the MCL values and revise as needed for all pertinent sections of this document.

EnSafe/Navy Response 3:

The text will be revised to clarify that the results were compared to the lower of tap water RBCs, MCLs, and background. This information was presented in Table 10.4.7 which shows that there were no exceedances for the lower of these values for each of the respective inorganics.

CH2M-Jones Response 3:

A replacement for page 10.4.42 has been provided to include the reference to MCLs.

Comment

4. Page 10.4.43, Section 10.4.5.1, Soil-to-Groundwater Cross-Media Transport. This paragraph states that a DAF of 10 was used. This paragraph does not indicate that the selected DAF is site specific or chosen as a generic figure. Please recalculate based on a recent Team meeting (I.E. Using site specific DAF) and revise where needed for all pertinent sections of this document.

EnSafe/Navy Response 4:

Please refer to [Susan] Byrd's, General Comment #1 [on the Navy's June 30, 1999 submittal].

CH2M-Jones Response 4:

Based on the February 2001 BCT meeting discussions, an SSL for VOCs based on DAF of 1 is appropriate. Re-screening of VOCs will be conducted as part of the CMS phase.

Comment

5. Page 10.4.63, Section 10.4.5.4, Fate and Transport Summary, lines 17-21. The paragraph states that certain BEQs were found above their respective RBCs and states that "the pathway is valid but not significant due to non-use of the resource." The State considers ALL groundwater in the State of South Carolina to be suited for drinking purposes and therefore must be as clean as the promulgated MCL/RBC tables for drinking water (See Water classifications & Standards-R.61-68, Classified Waters-R.61-69). Please revise this, as well as, future documents to reflect the fact that the idea of "no contact or use of the groundwater" is not a valid point to ignore the responsibility of the Navy to fully assess the groundwater.

EnSafe/Navy Response 5:

Statements such as this will be deleted from all future documents.

CH2M-Jones Response 5:

A replacement for page 10.4.63 has been provided to delete this reference.

Comment

6. Page 10.4.85, Section 10.4.6.6 Risk Uncertainty, Characterization of Exposure of Setting and Identification of Exposure Pathways, Lines 11-16. The Navy, in this paragraph states that the groundwater is not expected to be used at this site. See Comment number 5.

EnSafe/Navy Response 6:

Please refer to the response to [Michael Danielsen's] Comment #5 [on the Navy's June 30, 1999 submittal].

CH2M-Jones Response 6:

Replacement pages have been prepared to delete this reference (pages 10.4.85 and 10.4.85a).

Comment

7. Page 10.4.87, Sections 10.4.6.6 Groundwater, Lines 13-15. These lines state that arsenic and manganese were found in concentrations above their respective RBCs, but not above the background concentrations. Please revise and provide the detection levels for arsenic and manganese.

Please see comment #3.

EnSafe/Navy Response 7:

The method detection limits (MDL) can be provided but the Navy does not understand the relevance they have with respect to this particular comment what value will be added to the report by including them. The RBC for arsenic is very low at 0.045 µg/L, the MCL is 50 µg/L, and background is 23 µg/L. The MDL provided by one of the contract labs for arsenic analysis is 3.3 µg/L which is above the RBC. The maximum detection of arsenic at this site 11.6 µg/L. This result is obviously above the RBC, but below both background and the MCL. The RBC for manganese is 73 µg/L, background is 5,430 µg/L, and there is not an MCL. The MDL provided by one of the contract labs for manganese analysis is 1.2 µg/L. The maximum detection of manganese at this site 663 µg/L. This result is once again obviously above the RBC, but is an order of magnitude below background. Background risk and/or hazard for arsenic and manganese are greater than the site risk therefore they were not identified as COPCs.

CH2M-Jones Response 7:

CH2M-Jones concurs with the response provided by EnSafe/Navy. No additional action is necessary.

General Comments – AOC 678/679

Comment

8. There are six groundwater monitoring wells at this site, which should have been enough to establish seasonal and general groundwater flow directions. The groundwater flow direction for dry, wet, and general conditions has not been provided for this AOC. Please revise and provide the appropriate maps or drawings depicting the site specific groundwater flow.

EnSafe/Navy Response 8:

Potentiometric surface maps will be provided to document groundwater flow conditions at various points in time that coincide with groundwater sampling events and the data that will be presented graphically to show the distribution of groundwater COPCs.

CH2M-Jones Response 8:

CH2M-Jones does not concur that individual potentiometric maps for individual units are appropriate in Zone I. It is well known that shallow groundwater in areas adjacent to the Cooper

River are strongly influenced by tidal fluctuations and that the shallow groundwater discharges to the Cooper River. This was documented in CH2M-Jones's February 2001 submittal to SCDHEC: Interim Measures Report for Groundwater Monitoring Fiscal Year 2000.

Although there is quite a lot of groundwater elevation data available, if it were used to prepare potentiometric maps, it would be impossible to determine whether any variability reflected seasonal fluctuations or tidal effects. In addition, given the diurnal tidal cycle, it would also be impossible to separate tidal effects in samples collected on the same day in areas such as Zone I where the units of interest are located along the shoreline. For these reasons, CH2M-Jones provided base-wide documentation of groundwater flow patterns in the recent groundwater monitoring report.

Comment

9. The data for GDSB014 should be included in the text and tables for this site. Please include, in this document as well as future documents, all pertinent information relating to the particular site that is being addressed. If an appendix is referenced please state which section of appendix the information can be found. The appendixes are very large and also should be tabbed or marked by sample or AOC indication. Please revise as needed.

EnSafe/Navy Response 9:

The report will be revised as needed per the comment.

CH2M-Jones Response 9:

Replacement text pages are not necessary. The Zone I RFI Report, Revision 0 discusses GDSB014, although it is referenced in the text as GDISB014, which is the correct nomenclature for this location. The findings for GDISB014 are discussed in all appropriate subsections.

However, GDSB014 had been inadvertently omitted from Table 6.4.4. A revised replacement table is being provided (pages 10.4.10-29).

Divider sheets will be provided for the appendices for the Revision 0 RFI Report, as requested by SCDHEC staff (on an as-requested basis). For future documents, tabs, divider sheets, or other section delineators will be provided in the appendices to help identify where information is located and the report will state in which appendix the information can be found.

Comment

10. The data for GDI14D was not found in the text. See comment #9.

EnSafe/Navy Response 10:

A summary of the data for grid well 14D can be found in Section 10.14 which is a discussion of the results for all of the samples collected from the grid based locations. Please refer to Table 10.14.11 for the results.

CH2M-Jones Response 10:

CH2M-Jones concurs with the response provided by EnSafe/Navy. No action is necessary.

Comment

11. The number of samples taken AOC 679 are inadequate to properly characterize the contamination found at this site. The site needs additional samples to fill in data gaps and to

complete the RFI. All samples should be analyzed for a full scan of contaminants because the full operational history of the site is not known.

Groundwater: There needs to be a monitoring well downgradient from the location of the former USTs to look for possible contamination from the USTs.

Soils: There needs to be additional samples taken between 679SB011 and 678SB002. There also needs to be sample west of 678SB013. Samples should be added, as close as possible, in the center of the suspected wash rack area as well as the opposite corner from sample number 679SB015.

EnSafe/Navy Response 11:

The Navy believes that it would be beneficial to revise the introductory text for the AOC 678/679 discussion to clarify that AOC 679 was originally believed to be co-located with AOC 678 which is the reason for the co-mingled sample IDs. A later, detailed reviewed of historic figures revealed that, while the sites are in close proximity to one another, the data from one may not necessary be directly related to other. The maps and text in the nature and extent discussion will also have to be revised to clearly indicate which data points are being used for the characterization of each site. The majority of samples collected from these sites have been analyzed for a full scan. The Navy believes that there is a sufficient density of biased samples to identify any COPCs which may have been released from these sites.

Groundwater — Groundwater data was presented in the report that confirms petroleum contamination is present in the area down gradient of the tanks. Screening level samples were collected using DPT at locations 678GP001 and 678GP002 (Figure 10.4.1). The data are summarized as the "Fifth Round" results in Tables 10.4.6 and 10.4.8. Nothing further was done under the RFI after this data was obtained because the question arose whether the remaining characterization efforts should be completed under the RFI or the petroleum storage tank program. The Navy's tank program was asked to determine whether or not the tanks still exist or if they were removed. It is believed that an effort was made to determine the status of the tanks but the results are not currently known. Further discussion is required to determine the results of the tank search and a decision made which regulatory program will complete the characterization of the groundwater contamination that has been identified.

Soil — The comment requests additional samples between 679SB011 and 678SB002, and west of 678SB013, but does not state the reason for the request. The Navy would like clarification with respect to the basis for this comment prior to agreeing to whether additional work is needed or not. At the present time the Navy does not believe any data gaps exist in either of these areas. The decision to collect a groundwater sample on the downgradient side of the wash rack as confirmation of whether or not a release had occurred was made by the Project Team after it learned that the location of the wash rack was different from the area sampled during the initial stages of the RFI. The primary reason for taking this approach was the fact that the site is greater than 50 years old and it was assumed that if a significant release had occurred, the impacts would be seen in groundwater. The results of the initial groundwater sample were presented to SCDHEC at a meeting in October 1998. At that

meeting it was agreed the assessment was complete and the Navy should proceed with revising the RFI report. The well was sampled 3 additional times after the decision was made because of the general practice that primary wells used for characterization of a site should be sampled four times. No COPCs were ever identified. Now that a change in SCDHEC personnel has occurred, it appears the Department's opinion has changed. The Navy believes the decision made in October 1998 has been further validated by the additional rounds of groundwater data and that no further sampling is required at this site.

CH2M-Jones Response 11:

CH2M-Jones concurs with the response provided by EnSafe/Navy and the following will be provided:

- Replacement pages (pages 10.4.1 and 10.4.1a) for the introductory text are provided to clarify that AOC 679 was originally believed to be co-located with AOC 678, which is the reason for the co-mingled sample IDs. However, later review of historic figures revealed that while the sites are in close proximity to one another, the data from one may not necessarily be directly related to the other.*
- Based on the historical review, no new figures need to be generated. Although the sample IDs were co-mingled, all of them were used to characterize AOC 679, with the exception of the surface and subsurface soil samples collected at sample location 679SB015.*

Also, with respect to the need for additional samples in the vicinity of the former wash rack (AOC 678), the sample location 679SB015 represents the confirmatory sampling investigation (CSI) point, which is consistent with the recommendations of the RFA. No COCs were identified. In addition, based on the historical review, the wash rack operated only in 1943. Historical figures from 1942, 1943, and 1944 are provided to demonstrate this history (see Appendix B). Given the absence of COCs and the very short operational history of the wash rack nearly 60 years ago, no further investigation of this unit is necessary.

There is also no need to investigate the fire-fighting training area further. The investigation focused on the area where actual fire mock-ups were used for training purposes. A historical drawing of the mark-up areas is also provided for reference. As with AOC 678, the RFA recommended a CSI. Although the RFI report identified isodrin as a COC for this unit, rescreening using current screening criteria has shown that isodrin is, in fact, not a COC. This documentation will be provided as part of the CMS Work Plan being generated for this site.

- Clarification to SCDHEC, under separate cover, will be provided demonstrating that future responsibilities for the observed free product lie with the Tanks Program.*

Comment

12. The text is not clear if there was an O/W separator used in conjunction with the wash rack activities or the effluent was drained into the Cooper River. Please clarify.

EnSafe/Navy Response 12:

The only information pertaining to this site is that which can be inferred from a historic base map dated June 30, 1943 which was provided in Appendix H of the report. As indicated in a EnSafe Response to a previous round of comments, the wash rack was recommended for selection as an AOC simply on the basis of the name by a contractor performing a review of all of the historic base maps under contract to EPA. The 1943 map is the only year the wash rack appears on a map. The historic maps from this era do not provide an indication of whether or not a storm sewer system even existed. Even if storm sewer did exist, it is doubtful that an oil water separator was used as early as 1943. The Navy will research when the storm sewer system was installed at the southern end of the base and include that information in the report.

CH2M-Jones Response 12:

CH2M-Jones has completed its review of available information related to the presence or absence of an OWS associated with AOC 679 – Former Wash Rack. Based on this review, no evidence has been found to indicate that an OWS existed in conjunction with AOC 679. Given that the wash rack appears to have been demolished shortly after its single appearance on a 1943 base map, there does not appear to be any further information available. Therefore, no revision to the RFI Zone I RFI Report, Revision 0 is necessary in response to this comment.

Documents reviewed:

- Historical aerial photos
- RFA document
- Navy OWS Data (September 2000)

Comment

13. During a recent site visit the grouted DPT locations were not located in the parking lot. Please provide an explanation as to whether these points were grouted and/or paved over.

EnSafe/Navy Response 13:

Please refer to the response to [Susan] Peterson's Comment #4 [on the Navy's June 30, 1999 submittal].

CH2M-Jones Response 13:

CH2M-Jones concurs with the response provided by EnSafe/Navy to Susan Peterson Comment 4 from the June 30, 1999 submittal. No action is necessary.

Comment

14. Page 10.5.1, Section 10.5 AOC 680, Building NS-26 and Grinding Room/Brake Grinding Area, lines 7-9. The paragraph states that there were three dip tanks in the west part of the building. The text does not state the size of the dip tanks and the site map does not show the dip tanks in relation to the building. Please show the locations of these tanks on the drawing/map that is used in the report and indicate the size of the tanks on the map or in the text.

EnSafe/Navy Response 14:

The report will be revised per the comment.

CH2M-Jones Response 14:

CH2M-Jones has completed its review of available information in an attempt to respond to this comment with respect to the three dip tanks that EnSafe reported had been located in the western portion of Building NS-26. A visual inspection of this building was also conducted. Based on the limited information available, it appears that the three dip tanks were probably installed around 1983, sometime after the latest schematic was prepared for the building (1983), but the building schematics were never updated following installation of the tanks to include the specific dimensions, piping routes (if any), or placement. No purchasing records or demolition records were found.

During the site visit to visually inspect the area where the tanks were reported to have been located, CH2M-Jones discovered that NS-26 was completely renovated sometime in the late 1980s and now holds occupied office space. There were no visual traces of the tanks and nothing to indicate when or how they had been removed.

As a result, it will not be possible to update the Zone I RFI Report, Revision 0 Report for AOC 680 to show the location of the three dip tanks on the site figure or to revise the text to include information on the use, history, piping, age, dimensions or contents of the three dip tanks.

Comment

15. Page 10.5.14, Section 10.5.3 Groundwater Sampling and Analysis, lines 1-3. The paragraph states that three shallow and one deep well were installed. The three wells were described in detail including which formation they ended. The deep well was not described in any detail. Please clarify the depth of the deep well, which formation that it was terminated and why the deep well was only samples once. Please revise as needed.

EnSafe/Navy Response 15:

The report will be revised as needed per the comment.

CH2M-Jones Response 15:

A replacement for page 10.5.14 has been provided to include information on the deep well 680GP005.

Comment

16. Page 10.5.17, Table 10.5.8. The table shows that acetone and 2-butanone (MEK) were found to be above the tap water RBC in the first round. These analytes were not tested for in the second or third rounds to verify that the contaminants were in fact representative of the site. Please include these constituents as COCs into the CMS or additional samples maybe necessary deny the previous results. Please revise as needed.

EnSafe/Navy Response 16:

The detections presented in the table were in samples collected using DPT and were for screening only. Samples were collected from the permanent wells for these parameters in subsequent rounds as indicated in Table 10.5.6. These compounds were not detected in the permanent wells and will not be included as COCs.

CH2M-Jones Response 16:

CH2M-Jones concurs with the response provided by EnSafe/Navy. No action is necessary.

Comment

17. Page 10.5.16, Table 10.5.6 and Page 10.5.17, Table 10.5.8. The results from table 10.5.6 and 10.5.8 show two different results for BEHP. Table 10.5.6 states that BEHP was not detected and Table 10.5.8 state that the test for BEHP was not taken. Please revise to the correct terminology and clarify which statement is correct. Additional samples for BEHP may be needed for clarification.

EnSafe/Navy Response 17:

The text will be revised to provide clarification but the tables are correct. Table 10.5.6 is a summary, that is non-specific with respect to location, of compounds detected by sampling event, frequency of detection, range of concentrations, etc. Table 10.5.6 shows that BEHP was detected one time out of 8 total samples collected over 3 sampling events. Table 10.5.8 provides a location specific summary of detections. The table indicates that the one detection occurred at 680GP005 which is a sample collected using DPT methods. Unless a temporary well is installed, the DPT sampling method is a one time event which is the reason the table indicates no samples were collected from this particular location in the second and third rounds. Since BEHP was not detected in the samples collected from the permanent wells, the wells are listed in Table 10.5.8.

CH2M-Jones Response 17:

Replacement pages of the text have been provided to clarify the differences (pages 10.5.14 and 10.5.14a).

Comment

18. Page 10.5.40, Section 10.5.16 Human Health Risk Assessment, lines 15-16. This sentence states that three shallow wells were installed to characterize the zone groundwater. Part of groundwater characterization includes determining groundwater flow direction over a period of 2-3 quarters to assess the dry and wet groundwater flow directions. Please provide information and revise as needed.

EnSafe/Navy Response 18:

The report will be revised to provide sufficient groundwater flow information to determine if temporal variations in the groundwater flow direction exist.

CH2M-Jones Response 18:

See CH2M-Jones's response to Michael Danielsen's Comment 8 in the Navy's June 30, 1999 submittal.

General Comments-- AOC 680

Comment

19. The number of samples taken at AOC 680 are inadequate to properly characterize the contamination found at this site. The site needs additional samples to fill in data gaps and to complete the RFI. All samples should be analyzed for a full scan of contaminants. Samples need to be taken from the area beneath the building in the area of the dip tanks to determine the source for the contamination found in 680GP005. Samples are also needed outside the building on the west and south sides.

EnSafe/Navy Response 19:

Similar to the response to [Michael Daniels's] Comment #11 [on the Navy's June, 1999 submittal], this comment represents a departure from a previous agreement reached by the Project Team. The decision reached was that the site had been adequately characterized for purposes of the RFI. Data gaps remained at the completion of the RFI but, it was agreed the remainder of the characterization for this site should be completed under the petroleum program. A summary of the results of that assessment were not presented in the RFI because that work was completed subsequent to submittal of the report.

CH2M-Jones Response 19:

Clarification to SCDHEC, under separate cover, will be provided demonstrating that future responsibilities for the observed free product lie with the Tanks Program.

Comment

20. Acetone was found at 6800 µg/L which is well over the Tap Water RBC. However, this chemical was not found in Table 10.5.33 as a target for potential corrective measures. Please explain the process and rationale in which chemicals, such as arsenic, can be found to exceed the RBC or MCL promulgated levels and not be included for corrective measures.

EnSafe/Navy Response 20:

The result in question was from a screening sample collected using DPT. It was not detected in the site monitoring wells; therefore, it is not a COC. The presence of acetone as an artifact of the decontamination process was discussed in a memo submitted to the Project Team prior to the reviewer becoming a member of the Project Team. The Navy is willing to discuss the acetone hit in greater detail but does not believe the detection is an indication of it's presence in groundwater.

CH2M-Jones Response 20:

CH2M-Jones concurs with the response provided by EnSafe/Navy regarding the source of acetone. No action is necessary based on the prior agreement between SCDHEC and the CNC project team.

Comment

21. The text and site map show that the 200 gallon waste oil UST was removed. The sampling information including sampling location and analytical results from the removal of the 200 gallon waste oil UST should have been included in this report.

EnSafe/Navy Response 21:

The report will be revised to provide a summary of the information as it relates to the RFI; however, because the Department is provided with copies of the complete reports under the petroleum program, the Navy does not feel it is necessary to submit complete copies of redundant information.

CH2M-Jones Response 21:

Replacements pages have been provided to include information regarding the UST removal (pages 10.5.1 and 10.5.1a). In addition, a copy of the UST removal report is attached to this response to comments (see Appendix C).

Comment

22. The text states that the O/W separator (shown on the site map as being in the center of the building) was not found. The text further states that this O/W separator has been used by pouring oil down the pump-out pipe. Since this tank has been used for waste oil disposal, and appears that it may be continued to be used. The Navy must take steps to locate and ensure that a spill/leak has not occurred from this O/W separator under the building. Additional samples may be necessary. When sampling a O/W separator the analysis should be made for a full scan of contaminants.

EnSafe/Navy Response 22:

As mentioned previously, the assessment of releases from this system are being addressed by the petroleum program, not the RFI. The Navy feels that sufficient data has been collected during the RFI to document that the sampling done under the petroleum program will adequately complete the characterization of this site.

CH2M-Jones Response 22:

Replacement pages have been provided to include information relevant to the UST assessment (pages 10.5.1 and 10.5.1a).

Comment

23. There are four groundwater monitoring wells at this site, which should have been enough to establish seasonal and general groundwater flow directions. The groundwater flow direction for dry, wet, and general conditions has not been provided for this AOC. Please revise and provide the appropriate maps or drawings depicting the site specific groundwater flow.

EnSafe/Navy Response 23:

Please refer to the response to [Michael Danielsen's] Comment #18 [on the Navy's June 30, 1999 submittal].

CH2M-Jones Response 23:

CH2M-Jones concurs with the response provided by EnSafe/Navy. See response to Michael Danielsen's Comment 8 in the Navy's June 30, 1999 submittal.

Comment

24. Page 10.6.1, Section 10.6 AOC 681, Building 681 Blast Booth, lines 20-22. These lines state that dip tanks were used at this site. The text does not state the size of the dip tanks and the site map does not show the dip tanks in relation to the building. Please show the locations of these tanks on the drawing/map that is used in the report and indicate the size of the tanks on the map or in the text.

The sample ID's on the figure do not correspond to the sample ID's in the text and "Analytes Detected" tables. (I.E. Can not locate 681GW003, or DET samples) Please clarify.

EnSafe/Navy Response 24:

The report will be revised to include additional information regarding the dip tanks. The IDs presented on the figure are the actual monitoring well numbers. The IDs

presented in the tables are sample numbers which are based on a 10 digit system that was described in both the *Comprehensive Sampling and Analysis Plan* and is Section 3.2.1 of the Zone I report. Information regarding the DET samples was included in Appendix I of the report. It will be incorporated into the nature and extent discussion in the revised report.

CH2M-Jones Response 24:

Although this text discusses AOC 681, the dip tanks referred to in the text and in this comment are those reported in Building 680 (see page 10.6.1, lines 19-22). CH2M-Jones has completed a review of available information concerning the dip tanks in an attempt to respond to Mr. Danielsen's June 30, 1999 Comment 14, but adequate information could not be found.

With respect to AOC 681, the statement referenced by Mr. Danielsen from the RFI Report text is a generalized statement regarding the types of practices conducted at CNC for parts cleaning. No documentation was found that dip tanks actually existed in Building 681.

As a result, it will not be possible to update the RFI Report for AOC 681 to discuss the use of dip tanks in the text or to include information on the use, history, piping, age, dimensions or contents of the three dip tanks that were reported in Building NS-26.

Comment

25. Page 10.6.2, Section 10.6 AOC 681, Building 681 Blast Booth, lines 1-2. The text indicates that the O/W separator is still in use and serves both buildings 680 and 681. Please clarify if in fact it is still being used and whether samples have been taken in this area. This system is not currently on the site map provided in this report. Please revise to include this system on the site map.

EnSafe/Navy Response 25:

The requested information will be included in the revised report.

CH2M-Jones Response 25:

A replacement for page 10.6.2 has been provided to include information on the status of the oil/water separator in Building 681.

Comment

26. Page 10.6.3, Figure 10.6.1. The figure shows a location for an earlier AST before the current Building 681 was constructed. This AST is not mentioned in the text and therefore the previous contents and history of this tank is unknown. Please revise with this information.

The sample ID's on the figure do not correspond to the sample ID's in the text and "hits" tables. (I.E. Can not locate 681GW003, or DET samples) Please clarify.

EnSafe/Navy Response 26:

The report will be revised to include information pertaining to the tank. Please refer to the to [Michael Danielsen's] Comment #24 [on the Navy's June 30, 1999 submittal] for the second portion of this comment.

CH2M-Jones Response 26:

This comment addressed issues that fell on the same text page as another comment made by Susan Byrd (General Comment 2) in SCDHEC's June 30, 1999 comments. A replacement page

for page 10.6.1 has been provided which includes discussion of the AST. However, extensive review of historical documentation prior to Building 681's construction in 1984 did not provide any evidence for the existence of this former AST.

The following documents were reviewed:

- *Historical Public Works Maps from:*

1943	1946	1955
1962	1967	1968
1970	1974	1977
1978		
- *Historical aerial photographs (mostly undated)*
- *Navy's Environmental Baseline Survey for Building 681 (January 5, 1994)*
- *Final RCRA Facility Assessment for AOC 681 (June 1995)*

Comment

27. Page 10.6.6, Section 10.6.1 Soil Sampling and Analysis, lines 1-2. These lines state that the DET collected some samples for this location but does not state the sample numbers and does not represent sample locations found on the site map, figure 10.6.1. Please clarify and revise where needed.

EnSafe/Navy Response 27, Part 1:

Please refer to the response to [Michael Danielsen's] Comment #26 [on the Navy's June 30, 1999 submittal].

CH2M-Jones Response 27:

Replacement pages for the text and figure have been provided that include information regarding the DET sample numbers (page 10.6.7 and Figure 10.6.1).

Lines 2-4: The text states that samples 681SB00501 was only analyzed for SVOCs, TPH, and VOCs. Usually O/W separators were samples as though they were part of a virgin petroleum system, however O/W separators generally received other products than petroleum products. Metals are usually also found to be associated with O/W separators and this sample should have been analyzed for a full scan of contaminants. Additional samples maybe necessary.

The text does not also state whether or not this O/W separator has been removed or that the breached line was capped. Please clarify if the separator is still in place and if the lines were properly capped.

EnSafe/Navy Response 27, Part 2:

The suite of parameters for which the samples were analyzed is sufficient to provide and indication whether or not a release occurred, particularly under the circumstances described. The text states that a line was breached while attempting to collect a sample. The purpose of the sample was simply to provide confirmation that no oil had been released into the surrounding soil. If no oil was released then it is reasonable to assume no metals were released either. The explanation in the text will be expanded to provide additional information as requested in the comment.

CH2M-Jones Response 27, Part 2:

Replacement pages for the text have been provided (pages 10.6.6 and 10.6.6a).

Lines 13-17: These lines state that metals were analyzed for when another O/W separator was thought to be present. Please explain why some O/W separators were sampled for metals while others were not. Additional samples maybe needed.

EnSafe/Navy Response 27, Part 3:

Samples collected near O/W separators are typically analyzed for metals in addition to other parameters. In some instances the samples may not have been analyzed for metals but, the Navy does not believe this creates a potential data gap unless petroleum constituents are detected. In the absence of petroleum constituents, it is logical to assume that metals have not been released as well since they would have been contained in the oily waste. The reason the sample was not analyzed for metals at location 681SB00501 is explained above.

CH2M-Jones Response 27, Part 3:

CH2M-Jones concurs with the response provided by EnSafe/Navy. No action is necessary.

Comment

28. Page 10.6.30, Section 10.6.3 Groundwater Sampling and Analysis. This section states that the Geoprobe samples were only analyzed for VOCs and SVOCs, but do not offer an explanation as to why other analyses were not conducted. Additional samples maybe needed to be taken and be analyzed for a full scan of contaminants to complete the delineation of nature and extent. Please clarify and revise where needed.

EnSafe/Navy Response 28:

The samples collected using the Geoprobe were only analyzed for those constituents found in the samples collected from a permanent well. The objective was to delineate the extent of known constituents so the need for additional samples is unwarranted.

CH2M-Jones Response 28:

CH2M-Jones concurs with the response provided by EnSafe/Navy. No action is necessary.

Comment

29. Page 10.6.36, Section 10.6.4 Nature and Extent of Contamination in Groundwater, Inorganics in Groundwater. This subsection states that no inorganics exceeded RBC or MCL levels. However, Table 10.6.6 shows Thallium to have been found 2.4 µg/l. This level exceeds the MCL of 2 µg/l. Please revise as needed.

EnSafe/Navy Response 29:

The text states that "none of these detections exceeded the tap water RBC or MCL and shallow background". No revision is necessary.

CH2M-Jones Response 29:

CH2M-Jones concurs with the response provided by EnSafe/Navy. The background value for thallium in Zone I is 6.6 µg/L.

Comment

30. Page 10.6.42, Section 10.6.5.2 Groundwater Migration to Surface Water Cross-Media Transport, lines 15-18. Please see comment #5.

EnSafe/Navy Response 30:

Please refer to the response to [Michael Danielsen's] comment #5 [on the Navy's June 30, 1999 submittal].

CH2M-Jones Response 30:

A replacement for page 10.6.42 has been provided to delete this reference.

Comment

31. Page 10.6.49, Section 10.6.5.2 Groundwater Migration to Surface Water Cross Media Transport, lines 6-17. This paragraph states that Cu, Hg, Ag, were present in groundwater above screening values, and that upon discharge to the Cooper river, the concentrations of these metals will be diluted to insignificant levels. The idea of dilution alone is not a valid process to rely on for contaminant remediation. These contaminants must be addressed with more aggressive corrective action measures. Please re-evaluate this situation and revise/clarify as needed.

EnSafe/Navy Response 31:

The text will be revised appropriately so as not to imply that dilution alone is an acceptable means dealing with the inorganics detected above screening levels.

CH2M-Jones Response 31:

A replacement for page 10.6.49 has been provided to delete this reference.

Comment

32. Page 10.6.84, Section 10.6.6.6 Risk Uncertainty, Characterization of Exposure Setting and Identification of Exposure Pathways, Groundwater, lines 8-13. Please see comment #5.

EnSafe/Navy Response 32:

Please refer to the response to [Michael Danielsen's] Comment #5 [on the Navy's June 30, 1999 submittal].

CH2M-Jones Response 32:

A replacement for page 10.6.84 has been provided to delete this reference.

Comment

33. Page 10.6.107, Section 10.6.7 Corrective Measures Consideration, Table 10.6.33. This table does not include Thallium or Dibenzofuran as contaminants for possible CMS consideration. These contaminants were found to be above their respective RBC/MCL levels and must be addressed. Please clarify and revise.

EnSafe/Navy Response 33:

The Corrective Measures Consideration section only addresses those constituents identified as COCs in the baseline risk assessment. As mentioned above, thallium was not detected above background; therefore, it would not be included as a COC. The dibenzofuran was found in a screening level sample and not in a sample from a permanent monitoring well. Screening level data is not used in risk assessments.

CH2M-Jones Response 33:

CH2M-Jones concurs with the response provided by EnSafe/Navy. No action is necessary.

General Comments – AOC 681

Comment

34. There are seven groundwater monitoring wells at this site, which should have been enough to establish seasonal and general groundwater flow directions. The groundwater flow direction for dry, wet, and general conditions has not been provided for this AOC. Please revise and provide the appropriate maps or drawings depicting the site specific groundwater flow.

EnSafe/Navy Response 34:

Please refer to the response to [Michael Danielsen's] Comment #18 [on the Navy's June 30, 1999 submittal].

CH2M-Jones Response 34.

CH2M-Jones has submitted an installation-wide report titled Interim Measures Report for Groundwater Monitoring Fiscal Year 2000 (CH2M-Jones, February 2001). This report provides detailed groundwater maps that can be used to interpret flow for the various units in Zone I.

In addition, producing groundwater contour maps for each individual unit is impractical for two reasons:

- The overall number of wells for most units are too few to allow localized characterization of groundwater flow patterns, especially with respect to shallow vs. deep intervals.*
- The units in Zone I are all within a very short distance of the Cooper River. As a result, the groundwater in this area is subject to tidal effects and there is no corresponding tidal information to account for these influences.*

As a result, the best and most accurate representations of groundwater flow patterns in Zone I are found in the Interim Measures Report for Groundwater Monitoring Fiscal Year 2000.

Comment

35. The UST removal records were not provided or referenced. Please provide all information regarding the UST removals including sampling locations as well as analytical results.

EnSafe/Navy Response 35:

The RFI will appropriately summarize or reference any information that compliments the RFI but, the Navy does not intend to duplicate the entire closure reports in the RFI since the Department is provided with a copy of this information.

CH2M-Jones Response 35:

Closure of the two USTs associated with AOC 681 was completed in 1997 and approved by SCDHEC in November 1997. The text addressing this revision has been included with the response to Michael Danielsen's Comment 26 from the June 30, 1999 submittal.

A copy of the SCDHEC closure approval letter is included in this comment response (see Appendix D).

Comment

36. The lack of information for the environmental conditions beneath the building is a major data gap. The Navy needs to define the conditions of all media underneath the building.

EnSafe/Navy Response 36:

The data for the samples collected beneath the footprint of the building were provided in Appendix I. The text on page 10.6.29 acknowledges contamination was detected under the building. The report will be revised to better incorporate this data into the nature and extent discussion.

CH2M-Jones Response 36:

Replacement pages for the text and figure have been provided that include information regarding the DET sample numbers (page 10.6.7 and Figure 10.6.1).

Comment

37. There were no samples taken around the AST. Additional samples maybe needed to complete the delineation of nature and extent is this area.

EnSafe/Navy Response 37:

The need for additional samples should be discussed during the resolution of these comments.

CH2M-Jones Response 37:

See the response to Michael Danielsen's Comment 26 from the June 30, 1999 submittal.

Comment

38. The site map depicts four storage tank locations. However the fuel line locations are not indicated on this map. Please provide a map that shows all fuel line locations.

EnSafe/Navy Response 38:

The site map will be revised to include the requested information.

CH2M-Jones Response 38:

CH2M-Jones has completed a review of available information related to the fuel line locations. No documentation was found regarding placement of UST fuel lines for any of the four storage tank locations. Therefore, no revision to the Zone I RFI Report, Revision 0 is necessary in response to this comment.

Documents reviewed:

- *Historical aerial photos*

- *RFA document*
- *Construction drawings*

Comment

39. The number of samples taken at AOC 681 are inadequate to properly characterize the contamination found at this site. The site needs additional samples to fill in data gaps and to complete the RFI. All samples should be analyzed for a full scan of contaminants. Samples need to be taken from the area beneath the building. Additional groundwater samples may be needed when the groundwater flow directions for this site are provided.

EnSafe/Navy Response 39:

With the possible exception of the former AST location, the Navy believes the site has been adequately characterized to complete the RFI.

CH2M-Jones Response 39:

CH2M-Jones concurs with the response provided by EnSafe/Navy. No action is necessary.

**SCDHEC Comments on the
February 28, 2001 CH2M-Jones Response to SCDHEC Comments
regarding the Zone I RFI Report, Rev. 0
Charleston Naval Complex (CNC), SCO 170 022 560**

**Response to Comments by Mihir Mehta
June 27, 2001**

Comment 1. It is stated throughout the responses that appropriate information will be developed and provided in the revised document(s) for review and approval. Please provide all appendices and support information in the revised RFI report(s) or other agreed upon documents as deemed appropriate.

There might be a possibility to divide the sites in Zone I into subgroups or individual sites based in their current status and future path forward. The Department recommends that the Navy provide the strategy for future corrective action direction based on the comment resolution/ scoping meeting. The goal is to provide adequate written documentation and the Departments approval in order to maintain the administrative file.

CH2M-Jones Response: The documentation requested had not been prepared at the time the initial CH2M-Jones submittal was submitted. CH2M-Jones wanted to be sure that the approaches proposed in their response to comments would adequately address the concerns raised by SCDHEC in their May and June 1999 review comments on the *Zone I RFI Report, Rev. 0*. As they were substantially acceptable, the revision materials are provided as a *Zone I RFI Report Addendum*, attached to this response to comments.

CH2M-Jones also concurs that a meeting to discuss the future corrective action strategy for Zone I is appropriate at this time. Opportunities for this meeting will be explored by SCDHEC, Navy and CH2M-Jones program management team.

Comment 2. Comment number 1 : AOCs 678/679. Figure 10.4.1. Please revise the figure to accurately locate the wash rack area and identify the sampling locations with respect to this site. The Department does not agree with the response for not changing the figure.

CH2M-Jones Response: Detailed review of historical drawings in the vicinity of AOCs 678 and 679 confirm that the location of the washrack, as shown in the current original figure is correct. The washrack is not shown in the 1942 public works drawing, is shown on the 1943 public works drawing, and is then not shown on the 1944 public works drawing. This suggests that the wash rack was only in existence for about one year.

Comment 3. Comment number 1: By Susan Byrd. Please change the response and reevaluate the SSL calculations and analysis based on the recent agreement between the CNC Tier I BCT. Please revisit the sites in the referenced document and provide a path forward based on the site-specific SSL evaluation.

CH2M-Jones Response: The original CH2M-Jones response to Ms. Byrd's comment was generated before the BCT agreement regarding SSLs was reached. Per Ms. Byrd's request, all VOCs detected in soil in Zone I during the RFI have been re-evaluated using generic SSLs with a DAF=1. No additional COCs were found, as a result of this reevaluation. This documentation will be provided on a site-by-site basis in the *Zone I CMS Work Plan* that will be submitted following final approval of the *Zone I RFI Report Addendum*, which is being submitted in conjunction with this response to comments.

SCDHEC Comments on the
February 28, 2001 CH2M-Jones Response to SCDHEC Comments
Charleston Naval Complex (CNC), SCO 170 022 560

Response to Michael W. Danielsen, June 27, 2001

Comment 1. Response to May 7, 1999 Comment #5. The Navy is basing their conclusions on assumptions that turbidity or exceeding pumping rates to being the cause of the high arsenic levels in well 2. The division of Hydrogeology would like to use scientific studies rather than assumptions to prove/disprove contaminant levels. The Navy, in the Response, stated that "the Navy proposes to collect another round of groundwater sampling using low flow techniques." A summation table is presented for arsenic concentrations and includes results from one round of low flow sampling, but no interpretation is provided to the information in the table. How many rounds of low flow sampling were completed?

The CH2M Hill Response states that no further investigation is necessary. However continued monitoring may be needed for the arsenic concentrations because well 2 was not resampled using the low flow techniques.

CH2M-Jones Response: The Navy still intends to address this issue through their tanks program. The Navy will respond, accordingly. However, as a UST issue, it should not hold up the completion of the RFI portion of the site activities.

Comment 2. Response to May 7, 1999 Comment #6. The response from CH2M-Jones states that further investigation is not needed. However based on the one round of low flow sampling shown in the table, continued monitoring may be needed at a minimum because the level of arsenic was found to be almost three times above the MCL of 50 ug/L.

CH2M-Jones Response: CH2M-Jones concurs that further monitoring may potentially be reasonable for this site. However, the issue is whether the nature and extent have been delineated. CH2M-Jones believes that this has been achieved and should not delay the RFI process. The issue will be revisited during the CMS Work Plan planning and scoping.

Comment 3. General comment on Response to June 30, 1999 Comments: Several responses state that additional information will be provide by revised tables and page changes. When will this additional information be provided?

CH2M-Jones Response: The proposed revisions were not submitted with the response to comments because it was necessary to verify that the proposed approaches would be acceptable. CH2M-Jones wanted to be sure that the approaches proposed in their response to comments would adequately address the concerns raised by SCDHEC in their May and June 1999 review comments on the *Zone I RFI Report, Rev. 0*. As they were substantially acceptable, the revision materials are provided as a *Zone I RFI Report Addendum*, attached to this response to comments.

Comment 4. Response to June 30, 1999 Comment # 21: In the CH2M Hill response they state that a copy of the UST removal is included. This report was not included.

CH2M-Jones Response: See response to Comment 3, above.

5. Response to June 30, 1999 Comment # 22: OWSs are usually not addressed under the UST program unless they are part of a virgin petroleum system. The majority of the OWS at the CNC are waste oil and other liquid waste tanks. Therefore the "standard sampling" under the USTs program is not sufficient to adequately characterize the possible contaminants that may

be present at OWS sites. Furthermore, this issue has been addressed under a separate investigation and this site should remain open until the OWS investigation is complete.

CH2M-Jones Response: As indicated in CH2M-Jones response to the initial comment [Danielsen 6/30/99; Comment 22] the February 27, 2001, this would be addressed as part of the RFI addendum. Please refer to the documentation provided under the tab: *M. Danielsen 6/30/99; Comment 22 of the Zone I RFI Report Addendum* which is being submitted attached to this response to comments.

Comment 6. Response to June 30, 1999 Comment # 27. The Division of Hydrogeology does not concur with the Navy or CH2M Hill response. Some OWS contained other wastes that may have contained chlorinated solvents and other constituents that could also contain metals. See comment # 5 in this document.

CH2M-Jones Response: See response to Comment 5, above.

Comment 7. Response to June 30, 1999 Comment # 28: The response does not address the original concern of the site not being fully characterized for a full scan of contaminants to include pesticides and metals.

CH2M-Jones Response: The initial RFI Work Plan did not include plans for any groundwater sampling as part of the RFI. However, the geoprobe groundwater samples collected in March 1998 from grid wells GDI013 and GDI013D were analyzed only for VOCs and SVOCs, both of which were detected. In October 1998, three permanent monitoring wells were installed and groundwater samples were collected to provide further delineation; these samples analyzed for an expanded suite of analytes that included VOCs, SVOCs, metals and cyanide. The third round of sampling was conducted in January 1999 and this time the groundwater samples were analyzed for the full suite of analytes: VOCs, SVOCs, pesticides, metals and cyanide. Based on the findings of the third sampling event, the analytical suite was again reduced to exclude pesticides. Consistent with RFI site characterization guidance, once the COPCs have been identified, it is not necessary to conduct full analyses when attempting to delineate the extent. Since a full suite was collected during the third sampling event and no pesticides were detected, it was appropriate to eliminate pesticides from the suite of analytes during the fourth sampling event.

Comment 8. Response to June 30, 1999 Comment # 39¹: The Navy responded that the 681 area where the former AST may need additional investigation and the need for additional sampling must be discussed as mentioned in the response to comment #37. The CH2M Hill response is not complete and is not acceptable at this time.

CH2M-Jones Response: In preparing the Zone I RFI Report Addendum, CH2M-Jones conducted extensive review of historical documents and was unable to establish the existence of this AST that was reported to exist prior to the construction of Building 681. A detailed explanation of the research is provided under the tab: *M. Danielsen 6/30/99; Comment 37 of the Zone I RFI Report Addendum* which is being submitted attached to this response to comments.

¹ This comment, as submitted by SCDHEC indicated that it was intended to address Michael Danielsen's June 30, 1999 Comment 39, which addressed concerns regarding documentation of underground storage tank supply lines. CH2M-Jones has assumed that the comment is actually addressing CH2M-Jones' response to Michael Danielsen's June 30, 1999 Comment 37, which addresses the former AST.

Replacement Pages

10.3.6 Nature and Extent of Contamination in Soil

Table 10.3.10 summarizes the organic analytical results for sediment. Table 10.3.11 summarizes the inorganic analytical results for sediment. Analytes detected in the sediment are included in the Table 10.3.4 summary. The analytical results are included in Appendix D.

Table 10.3.10
AOCs 675/676/677
Organic Analytical Results for Sediment (mg/kg)

Parameter	Frequency of Frequency	Range of Detection	Mean of Detection	Residential RBCs
Volatile Organic Compounds				
Acetone	1/1	95.0	95.0	780,000
Semivolatile Organic Compounds				
Pyrene	1/1	730	730	230,000
bis(2-Ethylhexyl)phthalate (BEHP)	1/1	840	840	
Pesticides and PCBs				
4,4'-DDD	1/1	6.5	6.5	2,700
4,4'-DDE	1/1	2.0	2.0	1,900
4,4'-DDT	1/1	2.8	2.8	1,900
Aldrin	1/1	0.34	0.34	38
Dieldrin	1/1	3.7	3.7	40
Endosulfan I	1/1	12.0	12.0	47,000
Endosulfan II	1/1	5.5	5.5	47,000
Endosulfan sulfate	1/1	2.0	2.0	47,000
Endrin	1/1	12.0	12.0	2,300
Endrin aldehyde	1/1	8.8	8.8	2,300
Heptachlor epoxide	1/1	4.0	4.0	70
Methoxychlor	1/1	6.6	6.6	39,000
alpha-BHC	1/1	0.59	0.59	100
Gamma-BHC	1/1	1.2	1.2	490

Notes:

NL = Not Listed

NA = Not Applicable/Not Available/Not Analyzed

µg/kg = micrograms per kilogram

Table 10.3.11
AOCs 675/676/677
Inorganic Analytical Results for Sediment (mg/kg)

Parameter	Frequency of Detection	Range of Detection	Mean of Detection	RBCs
Aluminum (Al)	1/1	3,190	3,190	7,800
Antimony (Sb)	1/1	0.22	0.22	3.1
Arsenic (As)	1/1	0.52	0.52	0.43
Barium (Ba)	1/1	12.4	12.4	550
Calcium (Cd)	1/1	3,460	3,460	16
Chromium (Cr)	1/1	10.9	10.9	39
Cobalt (Co)	1/1	0.63	0.63	470
Copper (Cu)	1/1	14.9	14.9	310
Iron (Fe)	1/1	3,680	3,680	NL
Lead(Pb)	1/1	30.1	30.1	400
Magnesium (Mg)	1/1	333	333	NL
Manganese (Mn)	1/1	23.9	23.9	160
Nickel (Ni)	1/1	16.6	16.6	160
Potassium (K)	1/1	156	156	NL
Sodium (Na)	1/1	276	276	NL
Tin (Sn)	1/1	1.9	1.9	4,700
Zinc (Zn)	1/1	66.2	66.2	2,300

Notes:

NL = Not Listed

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mg/kg = milligrams per kilogram

Volatile Organic Compounds in Sediment

Acetone (95.0 µg/kg) was the only VOC detected in sediment sample 675M000101.

Semivolatile Organic Compounds in Sediment

Two SVOCs – pyrene (730 µg/kg) and bis(2-ethylhexyl)phthalate (840 µg/kg) – were detected in the sediment sample.

10.3.6 Nature and Extent of Contamination in Soil

Table 10.3.10 summarizes the organic analytical results for sediment. Table 10.3.11 summarizes the inorganic analytical results for sediment. Analytes detected in the sediment are included in the Table 10.3.4 summary. The analytical results are included in Appendix D.

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Aldrin	1/1	0.34	0.34	38
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Endosulfan I	1/1	12.0	12.0	47,000
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Barium (Ba)	1/1	12.4	12.4	550
Calcium (Cd)	1/1	3,460	3,460	16
Chromium (Cr)	1/1	10.9	10.9	39
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Copper (Cu)	1/1	14.9	14.9	310
Iron (Fe)	1/1	3,680	3,680	NL
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Manganese (Mn)	1/1	23.9	23.9	160
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Semivolatile Organic Compounds in Sediment

Two SVOCs – pyrene (730 µg/kg) and bis(2-ethylhexyl)phthalate (840 µg/kg) – were detected in the sediment sample.

presents the risk and hazard for the exposure pathway. Since no VOCs were identified as COPCs in groundwater at the combined AOCs, the inhalation pathway was not addressed at this site.

Hypothetical Site Residents

For the ingestion pathway, the hazard indices for the adult and child resident are 1 and 3, respectively. The primary contributor to hazard indices for the groundwater ingestion pathway was thallium. No carcinogenic COPCs were identified in shallow groundwater; thus, no ILCR projections were made.

Future Site Workers

The hazard index for the ingestion exposure pathway was calculated to be 0.5. No carcinogenic COPCs were identified in shallow groundwater, and thus no ILCR projections were made.

Current Site Workers

Shallow groundwater is not currently used as a potable water source for the combined AOCs or other areas of Zone I. In the absence of a completed exposure pathway, no threat to human health is posed by reported shallow groundwater contamination.

COC Refinement

Further review and risk analysis will be conducted during the CMS phase of the RCRA corrective action process on the COCs identified in this RFI. This effort will be conducted to provide a check that current risk assessment guidance and procedures are being followed at the time the CMS is prepared.

COCs Identified

USEPA has established a generally acceptable risk range of 1E-04 to 1E-06, and a hazard index threshold of 1.0 (unity). As recommended by SCDHEC, a COC was considered to be any chemical

presents the risk and hazard for the exposure pathway. Since no VOCs were identified as COPCs in groundwater at the combined AOCs, the inhalation pathway was not addressed at this site.

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COC Refinement

Further review and risk analysis will be conducted during the CMS phase of the RCRA corrective action process on the COCs identified in this RFI. This effort will be conducted to provide a check that current risk assessment guidance and procedures are being followed at the time the CMS is prepared.

COCs Identified

USEPA has established a generally acceptable risk range of 1E-04 to 1E-06, and a hazard index threshold of 1.0 (unity). As recommended by SCDHEC, a COC was considered to be any chemical

contributing to a cumulative risk level of $1E-06$ or greater and/or a cumulative hazard index above 1.0, and whose individual ILCR exceeds $1E-06$ or whose hazard quotient exceeds 0.1.

For carcinogens, this approach is relatively conservative, because a cumulative risk level of $1E-04$ (and individual ILCR of $1E-06$) is recommended by USEPA Region IV as the trigger for establishing COCs. The specified COC selection method was used in order to provide a more comprehensive evaluation of chemicals contributing to carcinogenic risk or noncarcinogenic hazard

10.4 AOCs 678, Firefighter School, Former Building 2-V41¹, and AOC 679, Former Wash Rack

AOC 678 is the former site of Building 2-V41, the Firefighter School, northeast of Building NS-1 in the northeastern portion of the southern peninsula. The firefighting school was reportedly constructed in 1947 and demolished circa 1955. Controlled fires may have been ignited and extinguished onsite for firefighter training. No other details regarding the design features or operating practices were available. Currently, the area is a paved parking lot.

AOC 679 consists of a former wash rack noted on early CNC maps from the 1930s and 1940s. This former wash rack was located off the west edge of Building NS-1. No information is available regarding the design features, years of operation, or operating practices for the wash rack. It is assumed that activities at this unit included washing or cleaning of equipment in an external wash area.

AOC 679 was originally believed to be collocated with AOC 678, which resulted in co-mingled sample IDs, but later review of historic construction drawings revealed that the wash rack was present only in 1943 at a location near the southeastern corner of the former firefighter school.

Materials of concern at AOC 678/679 include petroleum hydrocarbons, VOCs, used oil, and grease. Currently, the paved parking lot is rarely used, therefore, potential receptors include workers that may be involved in invasive activities at the site. The ecology of the Cooper River is also a potential receptor.

¹ The Firefighter School is shown in historical data (Figure 2) to be located in Building 41 not Building 2-V as indicated in the Zone I RFI Report, Revision 0.

Soil and groundwater were sampled in accordance with the *Final Zone I RFI Work Plan*, (E/A&H, February 1995) and Section 3 of this report to fulfill CSI objectives. In March 1999, five geoprobe samples were collected on the eastern edge of AOC 678/679 at areas that were thought to correspond to former locations of “mock ups” for the old firefighter training area. An additional well/boring was located in the area of the former wash rack on September 1998.

AOCs 678 and 679 are included in the northern part of Zone I, which is a fully developed coastline and not considered relevant to the ecological risk assessment (ERA) based on lack of habitat and receptors. It is designated on Figure 8.2 as a “Non-Ecological Area”.

10.4 AOCs 678, Firefighter School, Former Building 41¹, and AOC 679, Former Wash Rack

AOC 678 is the former site of Building 41, the Firefighter School, northeast of Building NS-1 in the northeastern portion of the southern peninsula. The firefighting school was reportedly constructed in 1947 and demolished circa 1955. Controlled fires may have been ignited and extinguished onsite for firefighter training. No other details regarding the design features or operating practices were available. Currently, the area is a paved parking lot.

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Table 10.4.4
AOC 678/679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
Volatiles Organic Carbons (µg/kg)							
Acetone	678SB001	17	780000	NA	17	8000	NA
	678SB002	ND			25		
	678SB003	28			19		
	678SB006	ND			12.5		
	679SB002	15			NT		
	679SB003	50			NT		
	679SB004	16			NT		
	679SB005	ND			11		
	679SB006	8			NT		
	679SB007	31			NT		
	679SB008	38			NT		
	679SB009	49			ND		
	679SB010	ND			29		
	679SB011	16			8		
	GLDISB014	22			110		
Toluene	678SB001	ND	1600000	NA	1	6000	NA
	678SB003	4			7		
	678SB005	1			NT		
	678SB006	NT			5		
	678SB007	2			ND		
	678SB008	4			ND		
	678SB011	2			NT		
	678SB012	ND			2		
	679SB002	1			NT		
	679SB004	1			NT		
	679SB008	2			NT		
	679SB009	2			ND		
	679SB011	3			ND		
	679SB012	3			6		
	GLDISB014	3			2		

Table 10.4.4
AOC 678/679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
Trichlorotrifluoroethane	678SB001	4	230000000	NA	NT	NA	NA
Semivolatiles Organic Carbons (µg/kg)							
BEQs	678SB001	56	87	NA	NA	1600	NA
	678SB003	253			NA		
	678SB008	92			NA		
	678SB012	ND			128		
	679SB005	ND			0.05		
	679SB015	37			NA		
Benzo(a)anthracene	678SB003	180	870	NA	ND	800	NA
	678SB008	56			ND		
	678SB012	ND			75		
	679SB015	27			ND		
Benzo(a)pyrene	678SB001	45	87	NA	ND	4000	NA
	678SB003	200			ND		
	678SB008	69			ND		
	678SB012	ND			96		
	679SB015	29			ND		
Benzo(b)fluoranthene	678SB001	100	870	NA	ND	2500	NA
	678SB003	240			ND		
	678SB008	160			ND		
	678SB012	ND			220		
	679SB015	31			ND		
Benzo(k)fluoranthene	678SB001	110	8700	NA	ND	25000	NA
	678SB003	100			ND		
	678SB008	170			ND		
	678SB012	ND			230		
	679SB015	21			ND		
Chrysene	678SB003	200	87000	NA	ND	80000	NA
	678SB008	59			ND		
	678SB012	ND			110		

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 AOC 678/679
 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
Indeno(1,2,3-cd)pyrene	679SB005	ND			50		
	679SB015	23			ND		
	678SB003	97	870	NA	ND	7000	NA
	679SB015	21			ND		
1-Methylnaphthalene	678SB001	39	310000	NA	ND	72000	NA
2-Methylnaphthalene	678SB001	110	310000	NA	ND	230000	NA
Acetophenone	679SB008	240	780000	NA	NT	0.12	NA
Anthracene	678SB003	46	2300000	NA	ND	5900000	NA
Bis(2-ethylhexyl)phthalate (BEHP)	678SB006	240	46000	NA	ND	1800000	NA
	679SB015	55			ND		
Di-n-butylphthalate	678SB002	78	780000	NA	53	2300000	NA
	679SB005	80			70		
	679SB006	50			NT		
	679SB007	40			NT		
	679SB008	50			NT		
	679SB009	ND			70		
	679SB010	60			90		
	679SB011	60			220		
	GD1SB014	100			130		
Ethyl methacrylate	679SB011	40	700000	NA	ND	1500	NA
Fluoranthene	678SB001	50	310000	NA	ND	2100000	
	678SB003	330			ND		
	678SB008	76			ND		
	678SB012	ND			120		
	679SB005	ND			60		
	679SB010	ND			50		
	679SB015	26			ND		

Table 10.4.4
AOC 678/679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
Isodrin	679SB006	990	NA	NA	ND	NA	NA
	679SB007	1000			ND		
Methapyrilene	679SB007	50	NA	NA	ND	NA	NA
Naphthalene	678SB001	68	310000	NA	ND	42000	NA
	679SB008	60			NT		
Phenanthrene	678SB001	86	230000		ND	660000	NA
	678SB003	220			ND		
	678SB012	ND			67		
	678SB010	ND			40		
	679SB015	15			ND		
Pyrene	678SB001	80	230000	NA	ND	2100000	NA
	678SB003	330			ND		
	678SB008	68			ND		
	678SB012	ND			100		
	679SB005	ND			90		
	679SB010	ND			40		
	679SB015	33			ND		
Pesticides/PCBs (µg/kg)							
Aroclor-1260	679SB010	ND	320		27	1000	NA
4,4'-DDD	678SB001	22	2700	NA	ND	8000	NA
	678SB003	25			ND		
	678SB007	170			2.9		
	678SB008	120			ND		
	678SB012	77			42		
	679SB002	11.5			NT		
	679SB008	9.5			NT		
4,4'-DDE	678SB001	16	1900	NA	ND	27000	NA
	678SB003	54			3.7		
	678SB005	4			NT		

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Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
4,4'-DDT	678SB006	5.3			ND		
	678SB007	480			7.7		
	678SB008	110			ND		
	678SB012	31			28		
	679SB002	8.3			8.3		
	679SB005	13			13		
	679SB006	13			13		
	679SB009	7			7		
	678SB001	4.3	1900	NA	ND	16000	NA
	678SB006	7			ND		
	678SB007	42			ND		
	678SB008	86			ND		
	678SB012	ND			4.6		
	679SB015	5.1			ND		
	679SB006	2	350	NA	NT	1.3	NA
beta-BHC	679SB007	1.4			NT		
	GDISB014	1.6			ND		
Endrin	678SB003	6.2	2300	NA	ND	500	NA
	678SB008	12			ND		
	678SB012	6.1					
Endrin aldehyde	678SB001	1.3	2300	NA	ND	340	NA
	678SB003	1.2			ND		
	678SB012	1.2			ND		
	679SB005	1.2			ND		
	679SB006	1.1			NT		
Endosulfan I	GDISB014	1.7			ND		
Methoxychlor	678SB012	ND	39000	NA	4	80000	NA
	679SB006	22			NT		
	GDISB014	3.7			ND		

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 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
Organophosphate Pesticides (µg/kg)							
Famphur	678SB006	ND	47000	NA	5.7	27000	NA
Methyl parathion	679SB002	3.9	2000	NA	NT	150	
Phorate	679SB011	10	1.6	NA	ND	820	
Herbicides (µg/kg)							
2,4,5-T	678SB006	ND	78000	NA	3.4	990	NA
Dioxins (ng/kg)							
Dioxin (2,3,7,8-TCDD TEQs)	678SB006	NT	4.3	NA	0.136	1600	NA
	679SB002	0.01			NT		
	679SB011	3.72			NT		
Organotins (µg/kg)							
Tributyltin	678SB007	ND	2300	NA	2.7	NA	NA
Inorganics (mg/kg)							
Aluminum (Al)	678SB001	6870	7800	27400	2180	560000	18900
	678SB002	5040			3070		
	678SB003	3090			2190		
	678SB005	5040			NT		
	678SB006	4640			978		
	678SB007	3660			3280		
	678SB008	4460			908		
	678SB011	4520			NT		
	678SB012	5740			8290		
	678SB013	7460			NT		
	678SB014	6170			NT		
	679SB002	5695			NT		
	679SB003	5690			NT		

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Table 10.4.4
 AOC 678/679
 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
Antimony (Sb)	679SB004	5030			NT		
	679SB005	5010			9150		
	679SB006	6850			NT		
	679SB007	7220			NT		
	679SB008	5690			NT		
	679SB009	6400			2730		
	679SB010	6820			1890		
	679SB011	3435			4800		
	679SB012	5230			5200		
	679SB015	7580			3570		
	679SB014	8680			7800		
	678SB013	0.35	3.1	ND	NT	2.7	ND
	678SB014	0.39			NT		
	679SB003	0.26			NT		
	679SB005	0.21			ND		
Arsenic (As)	678SB001	7.4	0.43	21.6	ND	15	6.45
	678SB002	ND			4.1		
	678SB008	ND			1		
	678SB011	1.3			NT		
	678SB012	0.7			7		
	678SB013	0.66			NT		
	678SB014	0.75			NT		
	679SB002	0.57			NT		
	679SB004	0.51			NT		
	679SB005	0.74			3.0		
	679SB006	0.45			NT		
	679SB007	0.45			NT		
	679SB008	0.6			NT		
	679SB009	0.4			0.73		
	679SB010	ND			0.54		
	679SB011	1.2			ND		
	679SB012	0.73			0.56		
	679SB015	1.7			2.6		

Table 10.4.4
AOC 678/679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
	<u>GDISH014</u>	<u>1.2</u>			<u>ND</u>		
Barium (Ba)	678SB001	40.9	550	54.2	7.2	820	36
	678SB002	7.1			14.7		
	678SB003	11.5			4.8		
	678SB005	10.5			NT		
	678SB006	10.9			4.4		
	678SB007	18.3			7		
	678SB008	14.8			3.6		
	678SB011	7.7			NT		
	678SB012	11			58.6		
	678SB013	11.5			NT		
	678SB014	11.6			NT		
	679SB002	17			NT		
	679SB003	9.7			NT		
	679SB004	5.9			NT		
	679SB005	8.1			13.9		
	679SB006	11.3			NT		
	679SB007	11.2			NT		
	679SB008	26.4			NT		
	679SB009	10.1			6.4		
	679SB010	10.7			6.1		
	679SB011	9.5			12.5		
	679SB012	6.9			7.9		
	679SB015	30.2			11		
	<u>GDISH014</u>	<u>1180</u>			<u>29.8</u>		
Beryllium (Be)	678SB001	0.41	16	0.95	ND	32	0.67
	678SB002	ND			0.28		
	678SB007	ND			0.22		
	678SB012	ND			0.52		
	679SB003	0.03			NT		
	679SB004	0.07			NT		
	679SB005	0.11			0.24		
	679SB006	0.06			NT		

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Table 10.4.4
 AOC 678/679
 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
Cadmium (Cd)	679SB007	0.04			NT		
	679SB008	0.17			NT		
	679SB009	0.08			0.15		
	679SB010	0.04			0.11		
	679SB011	0.14			0.14		
	679SB012	0.08			0.09		
	679SB015	0.18			0.42		
	678SB001	0.50	7.8	0.61	ND	4	0.54
	678SB007	0.12			0.09		
	678SB008	0.17			ND		
	678SB011	0.16			NT		
	678SB012	ND			0.44		
	679SB015	0.44			0.36		
Chromium (Cr)	678SB001	27.7	39	34.5	10	19	51.3
	678SB002	6.5			13.8		
	678SB003	28			16.5		
	678SB005	29.5			NT		
	678SB006	116			5.4		
	678SB007	11.9			14.4		
	678SB008	35.8			5.1		
	678SB011	10.7			NT		
	678SB012	36.6			25.3		
	678SB013	41.7			NT		
	678SB014	34.5			NT		
	679SB002	44.8			NT		
	679SB003	7.7			NT		
	679SB004	8.5			NT		
	679SB005	12.1			28.3		
	679SB006	13.9			NT		
	679SB007	15.2			NT		
	679SB008	21.8			NT		
	679SB009	8.7			8.7		
	679SB010	10.5			7.3		

Table 10.4.4
AOC 678/679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
	679SB011	32.1			10		
	679SB012	16.6			16.5		
	679SB015	18.1			13.3		
	GDISB014	268			23.2		
Cobalt (Co)	678SB001	3.9	470	5.8	ND	990	3.48
	678SB002	ND			1.2		
	678SB003	10.7			1.6		
	678SB006	1			ND		
	678SB007	0.75			1		
	678SB008	1.1			ND		
	678SB011	1.2			NT		
	678SB012	1.1			4.6		
	678SB013	0.81			NT		
	678SB014	1.5			NT		
	679SB002	0.95			NT		
	679SB003	0.64			NT		
	679SB004	0.78			NT		
	679SB005	0.83			1.7		
	679SB006	0.9			NT		
	679SB007	0.88			NT		
	679SB008	0.65			NT		
	679SB009	0.8			0.68		
	679SB010	0.76			0.51		
	679SB011	1			1.4		
	679SB012	1			0.86		
	679SB015	0.92			1.7		
	GDISB014	4			ND		
Copper (Cu)	678SB001	15.1	310	240	3.9	5600	11.5
	678SB002	ND			3		
	678SB003	5.6			3.3		
	678SB006	1.9			1.1		
	678SB007	15.7			4.8		
	678SB008	7.1			0.76		

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Table 10.4.4
 AOC 678/679
 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
	678SB011	2.5			NT		
	678SB012	1.8			67.3		
	678SB013	0.89			NT		
	678SB014	2.8			NT		
	679SB002	2.2			NT		
	679SB005	1.7			3.1		
	679SB006	2.8			NT		
	679SB008	1.7			NT		
	679SB009	1.2			1.4		
	679SB011	2.5			1.2		
	679SB012	1.2			2.1		
	679SB015	7.6			1.4		
	GD15B014	6.2			ND		
Lead(Pb)	678SB001	13.1	400	203	2.9	400	12.3
	678SB002	3.9			6.8		
	678SB003	10.5			2.2		
	678SB005	4.3			NT		
	678SB006	4.5			1.8		
	678SB007	31			3		
	678SB008	25.5			1.8		
	678SB011	8.7			NT		
	678SB012	7.4			468		
	678SB013	5.5			NT		
	678SB014	5.5			NT		
	679SB002	3.5			NT		
	679SB003	5.2			NT		
	679SB004	4			NT		
	679SB005	4.7			6.6		
	679SB006	8.3			NT		
	679SB007	5.5			NT		
	679SB008	6.2			NT		
	679SB009	5.6			4.4		
	679SB010	5			3.1		
	679SB011	4.1			3.7		

Table 10.4.4
 AOC 678/679
 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
	679SB012	3.9			5.3		
	679SB015	24.2			2.1		
	GDISB014	5.8			6.4		
Manganese (Mn)	678SB001	35.8	160	419	27.4	480	118
	678SB002	7.5			31.7		
	678SB003	34.9			19.9		
	678SB005	18.3			NT		
	678SB006	62.7			13.1		
	678SB007	30.8			38.4		
	678SB008	27.6			ND		
	678SB011	64			NT		
	678SB012	ND			338		
	678SB013	23.2			NT		
	678SB014	43.4			NT		
	679SB002	60.3			NT		
	679SB003	10.4			NT		
	679SB004	28.1			NT		
	679SB005	23.9			58.4		
	679SB006	13.8			NT		
	679SB007	14.7			NT		
	679SB008	61.6			NT		
	679SB009	15.8			24.4		
	679SB010	25.7			17.6		
	679SB011	35.3			16.5		
	679SB012	39.3			29.2		
	679SB015	81.4			46.8		
	GDISB014	254			62.7		
Mercury (Hg)	678SB001	0.29	2.3	0.47	ND	1	ND
	678SB007	0.24			ND		
	678SB008	0.12			ND		
	678SB012	ND			3.1		
	679SB015	0.13			ND		

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Table 10.4.4
 AOC 678/679
 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THIQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
Nickel (Ni)	678SB001	7.1	160	23.9	ND	65	15.7
	678SB002	2			5.6		
	678SB003	4.1			5.5		
	678SB005	1.9			NT		
	678SB006	3.2			1.15		
	678SB007	2.6			5.2		
	678SB008	3.9			0.92		
	678SB011	4.1			NT		
	678SB012	2.4			13.3		
	678SB013	3.1			NT		
	678SB014	3			NT		
	679SB002	3			NT		
	679SB003	2.1			NT		
	679SB004	3.3			NT		
	679SB005	3			6.1		
	679SB006	3.5			NT		
	679SB007	2.8			NT		
	679SB008	2.5			NT		
	679SB009	2.8			2.2		
	679SB010	3			1.2		
	679SB011	3.1			1.8		
	679SB012	2.9			4		
	679SB015	9.3			3.3		
	679SB014	7.3			ND		
Selenium (Se)	678SB001	0.78	39	1.49	ND	2.6	1.77
	678SB002	ND			0.85		
	678SB003	ND			0.69		
	678SB007	0.5			0.6		
	678SB008	0.51			ND		
	678SB012	ND			0.67		
	679SB004	0.49			NT		
	679SB005	ND			0.79		
	679SB009	0.82			0.58		
	679SB011	0.57			ND		

Table 10.4.4
AOC 678/679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
Tin (Sn)	679SB015	ND			0.2		
	GD1SB014	0.82			ND		
	678SB002	1.3	4700	7.5	ND	5500	ND
	678SB003	1.2			ND		
	678SB005	1.4			NT		
	678SB006	1.5			1.3		
	678SB007	2.2			ND		
	678SB008	1.5			1.5		
	678SB011	1			NT		
	678SB012	1.2			2.4		
	678SB013	1.8			NT		
	678SB014	1.4			NT		
	679SB002	1.2			NT		
	679SB003	1.7			NT		
	679SB004	0.99			NT		
	679SB006	1.1			NT		
	679SB009	1.1			ND		
	679SB011	1			1.1		
	679SB012	0.97			1.1		
Vanadium (V)	678SB001	12.2	55	113	5.3	3000	38.1
	678SB002	7.6			10.5		
	678SB003	6.8			8.2		
	678SB005	7.8			NT		
	678SB006	5.9			3		
	678SB007	6.4			10.5		
	678SB008	8.2			3.6		
	678SB011	6.9			NT		
	678SB012	9.2			18.2		
	679SB002	7.5			NT		
	679SB003	9.7			NT		
	679SB004	5.4			NT		
	679SB005	6.9			15.6		
	679SB006	10.5			NT		

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Table 10.4.4
 AOC 678/679
 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=10)	Subsurface Background
	679SB007	11.8			NT		
	679SB008	9.2			NT		
	679SB009	9.6			6		
	679SB010	10.8			4.5		
	679SB011	8.8			6.7		
	679SB012	5.7			6.6		
	679SB015	32.3			9.4		
	GD15B014	17.5			12.4		
Zinc (Zn)	678SB001	30.9	23000	206	11.5	6200	36.2
	678SB002	4.9			16.5		
	678SB003	35.1			20.6		
	678SB005	4.7			NT		
	678SB006	5			6.1		
	678SB007	61.8			18.2		
	678SB008	87.6			7.4		
	678SB011	15.8			NT		
	678SB012	7.7			189		
	678SB013	4.2			NT		
	678SB014	4.3			NT		
	679SB002	9.5			NT		
	679SB003	6.5			NT		
	679SB004	7.5			NT		
	679SB005	10.5			16.3		
	679SB006	9.9			NT		
	679SB007	8.5			NT		
	679SB008	6.3			NT		
	679SB009	7.7			9.5		
	679SB010	5.3			7		
	679SB011	13.5			8.8		
	679SB012	7.8			9.6		
	679SB015	46			11.6		
	GD15B014	9.6			6.4		

Notes:

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil to groundwater SSLs (IDAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996) were used as a reference concentration for lower interval samples.

ND = Not detected.

NT = Not taken.

NL = Not listed.

NA = Not applicable.

Bolded concentrations exceed both the reference concentration (RBC or SSL) and the zone background.

All background reference values for Zone I are based on twice the means of the grid sample concentrations.

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Table 10.4.4
 Zone I
 AOC 678 and AOC 679
 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Volatiles Organic Carbons (µg/kg)							
Acetone	678SB001	17	780000	NA	17	800	NA
	678SB002	ND			25		
	678SB003	28			19		
	678SB006	ND			12.5		
	679SB002	15			NT		
	679SB003	50			NT		
	679SB004	16			NT		
	679SB005	ND			11		
	679SB006	8			NT		
	679SB007	31			NT		
	679SB008	38			NT		
	679SB009	49			ND		
	679SB010	ND			29		
	679SB011	16			8		
	GDISB014	22			110		
Toluene	678SB001	ND	1600000	NA	1	6000	NA
	678SB003	4			7		
	678SB005	1			NT		
	678SB006	NT			5		
	678SB007	2			ND		
	678SB008	4			ND		
	678SB011	2			NT		
	678SB012	ND			2		
	679SB002	1			NT		
	679SB004	1			NT		
	679SB008	2			NT		
	679SB009	2			ND		
	679SB011	3			ND		
	679SB012	3			6		
	GDISB014	3			2		

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Table 10.4.4
Zone I
AOC 678 and AOC 679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Trichlorotrifluoroethane	678SB001	4	230000000	NA	NT	NA	NA
Semivolatiles Organic Carbons (µg/kg)							
BEQs	678SB001	56	87	NA	NA	1600	NA
	678SB003	253			NA		
	678SB008	92			NA		
	678SB012	ND			128		
	679SB005	ND			0.05		
Benzo(a)anthracene	679SB015	37	870	NA	NA	800	NA
	678SB003	180			ND		
	678SB008	56			ND		
	678SB012	ND			75		
	679SB015	27			ND		
Benzo(a)pyrene	678SB001	45	87	NA	ND	4000	NA
	678SB003	200			ND		
	678SB008	69			ND		
	678SB012	ND			96		
	679SB015	29			ND		
Benzo(b)fluoranthene	678SB001	100	870		ND	2500	NA
	678SB003	240			ND		
	678SB008	160			ND		
	678SB012	ND			220		
	679SB015	31			ND		
Benzo(k)fluoranthene	678SB001	110	8700		ND	25000	NA
	678SB003	100			ND		
	678SB008	170			ND		
	678SB012	ND			230		
	679SB015	21			ND		

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Table 10.4.4
Zone I
AOC 678 and AOC 679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Chrysene	678SB003	200	87000	NA	ND	80000	NA
	678SB008	59			ND		
	678SB012	ND			110		
	679SB005	ND			50		
	679SB015	23			ND		
Indeno(1,2,3-cd)pyrene	678SB003	97	870	NA	ND	7000	NA
	679SB015	21			ND		
1-Methylnaphthalene	678SB001	39	310000	NA	ND	72000	NA
2-Methylnaphthalene	678SB001	110	310000	NA	ND	230000	NA
Acetophenone	679SB008	240	780000	NA	NT	0.12	NA
Anthracene	678SB003	46	2300000	NA	ND	5900000	NA
	678SB006	240			ND		
Bis(2-ethylhexyl)phthalate	678SB006	240	46000	NA	ND	1800000	NA
	679SB015	55			ND		
Di-n-butylphthalate	678SB002	78	780000	NA	53	2300000	NA
	679SB005	80			70		
	679SB006	50			NT		
	679SB007	40			NT		
	679SB008	50			NT		
	679SB009	ND			70		
	679SB010	60			90		
	679SB011	60			220		
	GDISB014	100			130		
Ethyl methacrylate	679SB011	40	700000	NA	ND	1500	NA

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Table 10.4.4
Zone I
AOC 678 and AOC 679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Fluoranthene	678SB001	50	310000	NA	ND	2100000	
	678SB003	330			ND		
	678SB008	76			ND		
	678SB012	ND			120		
	679SB005	ND			60		
	679SB010	ND			50		
	679SB015	26			ND		
Isodrin	679SB006	990	NA	NA	ND	NA	NA
	679SB007	1000			ND		
Methapyrilene	679SB007	50	NA	NA	ND	NA	NA
Naphthalene	678SB001	68	310000	NA	ND	42000	NA
	679SB008	60			NT		
Phenanthrene	678SB001	86	230000		ND	660000	NA
	678SB003	220			ND		
	678SB012	ND			67		
	678SB010	ND			40		
	679SB015	15			ND		
Pyrene	678SB001	80	230000	NA	ND	2100000	NA
	678SB003	330			ND		
	678SB008	68			ND		
	678SB012	ND			100		
	679SB005	ND			90		
	679SB010	ND			40		
	679SB015	33			ND		

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Table 10.4.4
Zone 1
AOC 678 and AOC 679
Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Pesticides/PCBs (µg/kg)							
Aroclor-1260	679SB010	ND	320		27	1000	NA
4,4'-DDD	678SB001	22	2700	NA	ND	8000	NA
	678SB003	25			ND		
	678SB007	170			2.9		
	678SB008	120			ND		
	678SB012	77			42		
	679SB002	11.5			NT		
	679SB008	9.5			NT		
4,4'-DDE	678SB001	16	1900	NA	ND	27000	NA
	678SB003	54			3.7		
	678SB005	4			NT		
	678SB006	5.3			ND		
	678SB007	480			7.7		
	678SB008	110			ND		
	678SB012	31			28		
	679SB002	8.3			8.3		
	679SB005	13			13		
	679SB006	13			13		
	679SB009	7			7		
4,4'-DDT	678SB001	4.3	1900	NA	ND	16000	NA
	678SB006	7			ND		
	678SB007	42			ND		
	678SB008	86			ND		
	678SB012	ND			4.6		
	679SB015	5.1			ND		
beta-BHC	679SB006	2	350	NA	NT	1.3	NA
	679SB007	1.4			NT		
	GD1SB014	1.6			ND		

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Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Endrin	678SB003	6.2	2300	NA	ND	500	NA
	678SB008	12			ND		
	678SB012	6.1					

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Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Endrin aldehyde	678SB001	1.3	2300	NA	ND	340	NA
	678SB003	1.2			ND		
	678SB012	1.2			ND		
	679SB005	1.2			ND		
	679SB006	1.1			NT		
Endosulfan I	GDISB014	1.7			ND		
Methoxychlor	678SB012	ND	39000	NA	4	80000	NA
	679SB006	22			NT		
	GDISB014	3.7			ND		
Organophosphate Pesticides (µg/kg)							
Famphur	678SB006	ND	47000	NA	5.7	27000	NA
Methyl parathion	679SB002	3.9	2000	NA	NT	150	
Phorate	679SB011	10	1.6	NA	ND	820	
Herbicides (µg/kg)							
2,4,5-T	678SB006	ND	78000	NA	3.4	990	NA
Dioxins (ng/kg)							
Dioxin (2,3,7,8-TCDD TEQs)	678SB006	NT	4.3	NA	0.136	1600	NA
	679SB002	0.01			NT		
	679SB011	3.72			NT		
Organotins (µg/kg)							
Tributyltin	678SB007	ND	2300	NA	2.7	NA	NA

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Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Inorganics (mg/kg)							
Aluminum (Al)	678SB001	6870	7800	27400	2180	560000	18900
	678SB002	5040			3070		
	678SB003	3090			2190		
	678SB005	5040			NT		
	678SB006	4640			978		
	678SB007	3660			3280		
	678SB008	4460			908		
	678SB011	4520			NT		
	678SB012	5740			8290		
	678SB013	7460			NT		
	678SB014	6170			NT		
	679SB002	5695			NT		
	679SB003	5690			NT		
	679SB004	5030			NT		
	679SB005	5010			9150		
	679SB006	6850			NT		
	679SB007	7220			NT		
	679SB008	5690			NT		
	679SB009	6400			2730		
	679SB010	6820			1890		
	679SB011	3435			4800		
	679SB012	5230			5200		
	679SB015	7580			3570		
	GDISB014	8680			7800		
Antimony (Sb)	678SB013	0.35	3.1	ND	NT	2.7	ND
	678SB014	0.39			NT		
	679SB003	0.26			NT		
	679SB005	0.21			ND		

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 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Arsenic (As)	678SB001	7.4	0.43	21.6	ND	15	6.45
	678SB002	ND			4.1		
	678SB008	ND			1		
	678SB011	1.3			NT		
	678SB012	0.7			7		
	678SB013	0.66			NT		
	678SB014	0.75			NT		
	679SB002	0.57			NT		
	679SB004	0.51			NT		
	679SB005	0.74			3.0		
	679SB006	0.45			NT		
	679SB007	0.45			NT		
	679SB008	0.6			NT		
	679SB009	0.4			0.73		
	679SB010	ND			0.54		
	679SB011	1.2			ND		
	679SB012	0.73			0.56		
	679SB015	1.7			2.6		
	GDISB014	1.9			ND		

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Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Barium (Ba)	678SB001	40.9	550	54.2	7.2	820	36
	678SB002	7.1			14.7		
	678SB003	11.5			4.8		
	678SB005	10.5			NT		
	678SB006	10.9			4.4		
	678SB007	18.3			7		
	678SB008	14.8			3.6		
	678SB011	7.7			NT		
	678SB012	11			58.6		
	678SB013	11.5			NT		
	678SB014	11.6			NT		
	679SB002	17			NT		
	679SB003	9.7			NT		
	679SB004	5.9			NT		
	679SB005	8.1			13.9		
	679SB006	11.3			NT		
	679SB007	11.2			NT		
	679SB008	26.4			NT		
	679SB009	10.1			6.4		
	679SB010	10.7			6.1		
	679SB011	9.5			12.5		
	679SB012	6.9			7.9		
	679SB015	30.2			11		
	GD1SB014	1180			29.8		

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Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Beryllium (Be)	678SB001	0.41	16	0.95	ND	32	0.67
	678SB002	ND			0.28		
	678SB007	ND			0.22		
	678SB012	ND			0.52		
	679SB003	0.03			NT		
	679SB004	0.07			NT		
	679SB005	0.11			0.24		
	679SB006	0.06			NT		
	679SB007	0.04			NT		
	679SB008	0.17			NT		
	679SB009	0.08			0.15		
	679SB010	0.04			0.11		
	679SB011	0.14			0.14		
	679SB012	0.08			0.09		
	679SB015	0.18			0.42		
Cadmium (Cd)	678SB001	0.50	7.8	0.61	ND	4	0.54
	678SB007	0.12			0.09		
	678SB008	0.17			ND		
	678SB011	0.16			NT		
	678SB012	ND			0.44		
	679SB015	0.44			0.36		

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Analytes Detected in Surface and Subsurface Soil**

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Chromium (Cr)	678SB001	27.7	39	34.5	10	19	51.3
	678SB002	6.5			13.8		
	678SB003	28			16.5		
	678SB005	29.5			NT		
	678SB006	116			5.4		
	678SB007	11.9			14.4		
	678SB008	35.8			5.1		
	678SB011	10.7			NT		
	678SB012	36.6			25.3		
	678SB013	41.7			NT		
	678SB014	34.5			NT		
	679SB002	44.8			NT		
	679SB003	7.7			NT		
	679SB004	8.5			NT		
	679SB005	12.1			28.3		
	679SB006	13.9			NT		
	679SB007	15.2			NT		
	679SB008	21.8			NT		
	679SB009	8.7			8.7		
	679SB010	10.5			7.3		
	679SB011	32.1			10		
	679SB012	16.6			16.5		
	679SB015	18.1			13.3		
	GDISB014	268			23.2		

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Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Cobalt (Co)	678SB001	3.9	470	5.8	ND	990	3.48
	678SB002	ND			1.2		
	678SB003	10.7			1.6		
	678SB006	1			ND		
	678SB007	0.75			1		
	678SB008	1.1			ND		
	678SB011	1.2			NT		
	678SB012	1.1			4.6		
	678SB013	0.81			NT		
	678SB014	1.5			NT		
	679SB002	0.95			NT		
	679SB003	0.64			NT		
	679SB004	0.78			NT		
	679SB005	0.83			1.7		
	679SB006	0.9			NT		
	679SB007	0.88			NT		
	679SB008	0.65			NT		
	679SB009	0.8			0.68		
	679SB010	0.76			0.51		
	679SB011	1			1.4		
	679SB012	1			0.86		
	679SB015	0.92			1.7		
	GDISB014	4			ND		

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 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Copper (Cu)	678SB001	15.1	310	240	3.9	5600	11.5
	678SB002	ND			3		
	678SB003	5.6			3.3		
	678SB006	1.9			1.1		
	678SB007	15.7			4.8		
	678SB008	7.1			0.76		
	678SB011	2.5			NT		
	678SB012	1.8			67.3		
	678SB013	0.89			NT		
	678SB014	2.8			NT		
	679SB002	2.2			NT		
	679SB005	1.7			3.1		
	679SB006	2.8			NT		
	679SB008	1.7			NT		
	679SB009	1.2			1.4		
	679SB011	2.5			1.2		
	679SB012	1.2			2.1		
	679SB015	7.6			1.4		
	GDISB014	6.2			ND		

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 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Lead(Pb)	678SB001	13.1	400	203	2.9	400	12.3
	678SB002	3.9			6.8		
	678SB003	10.5			2.2		
	678SB005	4.3			NT		
	678SB006	4.5			1.8		
	678SB007	31			3		
	678SB008	25.5			1.8		
	678SB011	8.7			NT		
	678SB012	7.4			468		
	678SB013	5.5			NT		
	678SB014	5.5			NT		
	679SB002	3.5			NT		
	679SB003	5.2			NT		
	679SB004	4			NT		
	679SB005	4.7			6.6		
	679SB006	8.3			NT		
	679SB007	5.5			NT		
	679SB008	6.2			NT		
	679SB009	5.6			4.4		
	679SB010	5			3.1		
	679SB011	4.1			3.7		
	679SB012	3.9			5.3		
	679SB015	24.2			2.1		
	GDISB014	5.8			6.4		

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Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Manganese (Mn)	678SB001	35.8	160	419	27.4	480	118
	678SB002	7.5			31.7		
	678SB003	34.9			19.9		
	678SB005	18.3			NT		
	678SB006	62.7			13.1		
	678SB007	30.8			38.4		
	678SB008	27.6			ND		
	678SB011	64			NT		
	678SB012	ND			338		
	678SB013	23.2			NT		
	678SB014	43.4			NT		
	679SB002	60.3			NT		
	679SB003	10.4			NT		
	679SB004	28.1			NT		
	679SB005	23.9			58.4		
	679SB006	13.8			NT		
	679SB007	14.7			NT		
	679SB008	61.6			NT		
	679SB009	15.8			24.4		
	679SB010	25.7			17.6		
	679SB011	35.3			16.5		
	679SB012	39.3			29.2		
	679SB015	81.4			46.8		
	GDISB014	254			62.7		
Mercury (Hg)	678SB001	0.29	2.3	0.47	ND	1	ND
	678SB007	0.24			ND		
	678SB008	0.12			ND		
	678SB012	ND			3.1		
	679SB015	0.13			ND		

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Table 10.4.4
 Zone I
 AOC 678 and AOC 679
 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Nickel (Ni)	678SB001	7.1	160	23.9	ND	65	15.7
	678SB002	2			5.6		
	678SB003	4.1			5.5		
	678SB005	1.9			NT		
	678SB006	3.2			1.15		
	678SB007	2.6			5.2		
	678SB008	3.9			0.92		
	678SB011	4.1			NT		
	678SB012	2.4			13.3		
	678SB013	3.1			NT		
	678SB014	3			NT		
	679SB002	3			NT		
	679SB003	2.1			NT		
	679SB004	3.3			NT		
	679SB005	3			6.1		
	679SB006	3.5			NT		
	679SB007	2.8			NT		
	679SB008	2.5			NT		
	679SB009	2.8			2.2		
	679SB010	3			1.2		
	679SB011	3.1			1.8		
	679SB012	2.9			4		
	679SB015	9.3			3.3		
	GDISB014	7.3			ND		

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Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Selenium (Se)	678SB001	0.78	39	1.49	ND	2.6	1.77
	678SB002	ND			0.85		
	678SB003	ND			0.69		
	678SB007	0.5			0.6		
	678SB008	0.51			ND		
	678SB012	ND			0.67		
	679SB004	0.49			NT		
	679SB005	ND			0.79		
	679SB009	0.82			0.58		
	679SB011	0.57			ND		
	679SB015	ND			0.2		
	GDISB014	0.82			ND		
Tin (Sn)	678SB002	1.3	4700	7.5	ND	5500	ND
	678SB003	1.2			ND		
	678SB005	1.4			NT		
	678SB006	1.5			1.3		
	678SB007	2.2			ND		
	678SB008	1.5			1.5		
	678SB011	1			NT		
	678SB012	1.2			2.4		
	678SB013	1.8			NT		
	678SB014	1.4			NT		
	679SB002	1.2			NT		
	679SB003	1.7			NT		
	679SB004	0.99			NT		
	679SB006	1.1			NT		
	679SB009	1.1			ND		
	679SB011	1			1.1		
	679SB012	0.97			1.1		

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 Analytes Detected in Surface and Subsurface Soil

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Vanadium (V)	678SB001	12.2	55	113	5.3	3000	38.1
	678SB002	7.6			10.5		
	678SB003	6.8			8.2		
	678SB005	7.8			NT		
	678SB006	5.9			3		
	678SB007	6.4			10.5		
	678SB008	8.2			3.6		
	678SB011	6.9			NT		
	678SB012	9.2			18.2		
	679SB002	7.5			NT		
	679SB003	9.7			NT		
	679SB004	5.4			NT		
	679SB005	6.9			15.6		
	679SB006	10.5			NT		
	679SB007	11.8			NT		
	679SB008	9.2			NT		
	679SB009	9.6			6		
	679SB010	10.8			4.5		
	679SB011	8.8			6.7		
	679SB012	5.7			6.6		
	679SB015	32.3			9.4		
	GDISB014	17.5			12.4		

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Analytes Detected in Surface and Subsurface Soil**

Parameter	Location	Surface Conc.	Residential RBC* (THQ=0.1)	Surface Background	Subsurface Conc.	Soil to Groundwater SSL* (DAF=20)	Subsurface Background
Zinc (Zn)	678SB001	30.9	23000	206	11.5	6200	36.2
	678SB002	4.9			16.5		
	678SB003	35.1			20.6		
	678SB005	4.7			NT		
	678SB006	5			6.1		
	678SB007	61.8			18.2		
	678SB008	87.6			7.4		
	678SB011	15.8			NT		
	678SB012	7.7			189		
	678SB013	4.2			NT		
	678SB014	4.3			NT		
	679SB002	9.5			NT		
	679SB003	6.5			NT		
	679SB004	7.5			NT		
	679SB005	10.5			16.3		
	679SB006	9.9			NT		
	679SB007	8.5			NT		
	679SB008	6.3			NT		
	679SB009	7.7			9.5		
	679SB010	5.3			7		
	679SB011	13.5			8.8		
	679SB012	7.8			9.6		
	679SB015	46			11.6		
	GDISB014	9.6			6.4		

Notes:

* = Residential RBCs (THQ=0.1) were used as a reference concentration for upper interval samples. Generic soil to groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996) were used as a reference concentration for lower interval samples.

ND = Not detected.

NT = Not taken.

NL = Not listed.

NA = Not applicable.

Bolded concentrations exceed both the reference concentration (RBC or SSL) and the zone background.

All background reference values for Zone I are based on twice the means of the grid sample concentrations.

subsurface soil. Lead and mercury exceeded their SSL and subsurface background concentration each in one sample. No other subsurface samples exceeded their SSL and background.

Twelve metals were detected in surface soil at grid soil boring GDISB014. Two metals, barium and chromium, exceed their RBC and surface background values in the surface soil sample. Barium was detected in the surface soil sample at 1180 mg/kg, and chromium at 268 mg/kg. The remaining surface samples did not exceed their respective RBC and background.

Nine metals were detected in the subsurface sample from GDISB014. None of these detections exceeded the SSL and background values.

10.4.3 Groundwater Sampling and Analysis

The *Final Zone I RFI Work Plan* (E/A&H, February 1995) proposed three shallow monitoring wells at AOC 678/679. Subsequent to the work plan, geoprobe samples were collected to further define the extent of contamination at former firefighter “mock up” areas, and a fourth well was installed at the wash rack site. Six rounds of groundwater sampling were completed. During the first round of sampling, wells were sampled for VOCs, SVOCs, metals, cyanide, pesticides, PCBs, organotins, chlorides, TDS, and sulfates at DQO Level III. Samples from rounds two and three were analyzed for cyanide and metals. Fourth round samples were analyzed for chloride, cyanide, sulfate, metals, pesticides, VOCs, and TDS. Fifth round samples were taken from five shallow and four deep geoprobe samples collected along the boundary between AOC 679 and 680. These samples were analyzed for VOCs and SVOCs. A duplicate sample was taken in rounds two, three, four, and five. Sixth round sampling was conducted on well 679001 only and samples were analyzed for VOCs only. In addition, a shallow and deep grid-based monitoring well pair, GDI014 and GDI14D, was proposed and installed for use in characterizing the zone perimeter groundwater. Table 10.4.5 summarizes the groundwater sampling at AOC 678/679.

It is also important to note that, following the fifth sampling event, the nature and extent of constituents associated with AOC 678 had been adequately defined. However, a sixth sampling event was conducted on monitoring well MW 679001, only. This well was sampled for VOCs because the fifth sampling event indicated the presence of detectable levels of several VOCs, even though the first, second, third and fourth events did not demonstrate the presence of VOCs at detectable concentrations and the fifth sampling event for wells from AOC 678 did not have any significant detections of VOC constituents. As a result, MW 679001 was the only well sampled during the sixth event.

It is also important to note that, following the fifth sampling event, the nature and extent of constituents associated with AOC 678 had been adequately defined. However, a sixth sampling event was conducted on monitoring well MW 679001, only. This well was sampled for VOCs because the fifth sampling event indicated the presence of detectable levels of several VOCs, even though the first, second, third and fourth events did not demonstrate the presence of VOCs at detectable concentrations and the fifth sampling event for wells from AOC 678 did not have any significant detections of VOC constituents. As a result, MW 679001 was the only well sampled during the sixth event.

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Table 10.4.7
 AOC 678/679
 Inorganic Analytical Results for Groundwater (µg/L)

Parameters	Sample Round	Detection Frequency	Detection Range	Mean	Tap Water RBC/MCL	Shallow Background	Number of Samples Exceeding Lower of RBC or MCL and Background
Aluminum (Al)	First	1/3	171	171	3,700/NL	1,440	0
	Second	2/3	31.7 - 204	118			0
	Third	0/3	ND	ND			0
	Fourth	2/3	26.2 - 69.1	47.7			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Arsenic (As)	First	1/3	5.3	5.3	0.045/50	23	0
	Second	0/3	ND	ND			0
	Third	1/3	11.6	11.6			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Barium (Ba)	First	1/3	11.3	11.3	260/2,000	2.3	0
	Second	2/3	10.1 - 17.6	13.9			0
	Third	0/3	ND	ND			0
	Fourth	2/3	14.9 - 21.8	18.4			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Cadmium (Cd)	First	1/3	0.30	0.30	1.8/5	NA	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Chromium (Cr)	First	2/3	1.6 - 1.7	1.65	18/100	14.3	0
	Second	2/3	1.3 - 2.65	1.98			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Lead (Pb)	First	2/3	2.6 - 3.5	3.05	15/15	4.4	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Manganese (Mn)	First	3/3	42.3 - 245	139	73/NL	5,430	0
	Second	2/3	220 - 338	279			0
	Third	1/3	663	663			0

Table 10.4.7
AOC 678/679
Inorganic Analytical Results for Groundwater (µg/L)

Parameters	Sample Round	Detection Frequency	Detection Range	Mean	Tap Water RBC/MCL	Shallow Background	Number of Samples Exceeding Lower of RBC or MCL and Background
	Fourth	2/3	126 - 187	157			0
	Fifth	0/0	ND	ND			0
	Sixth	1/1	42.3	42.3			0
Nickel (Ni)	First	2/3	1.5 - 2.5	2.0	73/100	13.3	0
	Second	0/3	ND	ND			0
	Third	1/3	1.9	1.9			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Selenium (Se)	First	0/3	ND	ND	18/50	ND	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	1/3	3.1	3.1 3.1			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Vanadium	First	1/3	1.0	1.0	26/NL	14	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Zinc (Zn)	First	1/3	11.5	11.5	1,100/NL	14	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0

Notes:

NA = Not applicable/Not available

ND = Not detected/Not determined

NL = Not listed

µg/L= micrograms per liter

See Table 5.6 for inorganic screening concentrations and their sources.

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Parameters	Sample Round	Detection Frequency	Detection Range	Mean	Tap Water RBC/MCL	Shallow Background	Number of Samples Exceeding Lower of RBC or MCL and Background
Aluminum (Al)	First	1/3	171	171	3,700/NL	1,440	0
	Second	2/3	31.7 - 204	118			0
	Third	0/3	ND	ND			0
	Fourth	2/3	26.2 - 69.1	47.7			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Arsenic (As)	First	1/3	5.3	5.3	0.045/50	23	0
	Second	0/3	ND	ND			0
	Third	1/3	11.6	11.6			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Barium (Ba)	First	1/3	11.3	11.3	260/2,000	2.3	0
	Second	2/3	10.1 - 17.6	13.9			0
	Third	0/3	ND	ND			0
	Fourth	2/3	14.9 - 21.8	18.4			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Cadmium (Cd)	First	1/3	0.30	0.30	1.8/5	NA	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Chromium (Cr)	First	2/3	1.6 - 1.7	1.65	18/100	14.3	0
	Second	2/3	1.3 - 2.65	1.98			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Lead (Pb)	First	2/3	2.6 - 3.5	3.05	15/15	4.4	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Manganese (Mn)	First	3/3	42.3 - 245	139	73/NL	5,430	0
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	Second	0/3	ND	ND			0
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	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Selenium (Se)	First	0/3	ND	ND	18/50	ND	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	1/3	3.1	3.1			0
	Fifth	0/0	ND	ND			0
	Sixth	0/1	ND	ND			0
Vanadium	First	1/3	1.0	1.0	26/NL	14	0
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	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/0	ND	ND			0
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Notes:

NA = Not applicable/Not available

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See Table 5.6 for inorganic screening concentrations and their sources.

In accordance with recent cPAH guidance and Section 7 of this report, BEQs were calculated for cPAHs at AOC 678/679. The BEQ for shallow groundwater sample 678GP002 is 0.063 $\mu\text{g/L}$, which exceeds the RBC for benzo(a) pyrene of 0.0092 $\mu\text{g/L}$.

Eight SVOCs were detected in deep groundwater geoprobe samples. All SVOCs were detected in the fifth round of sampling and none exceeded its tap-water RBC. Three SVOCs, benzoic acid, diethylphthalate, and phenol, were detected in deep groundwater at deep grid well GDI14D. All three SVOCs were far below their tap-water RBC.

Pesticides and PCBs in Groundwater

No pesticides or PCBs were detected in shallow groundwater samples collected at AOC 678/679.

Aroclor-1260 was detected in the shallow grid well GDI014. Aroclor-1260 was detected at 1.30 $\mu\text{g/L}$, exceeding its RBC of 0.0087 $\mu\text{g/L}$. No pesticides or PCBs were detected in the deep groundwater sample from GDI14D.

Inorganics in Groundwater

Eleven metals were detected in AOC 678/679 shallow groundwater samples. None of the detections exceeded the RBC and shallow background values.

In all, ten metals were detected during four groundwater sampling rounds at shallow grid well GDI014. All concentrations were far below their respective tap-water RBCs, MCLs, and shallow groundwater background concentrations. Ten metals were also detected during the four groundwater sampling rounds at deep grid well GDI14D. Again, all concentrations were far below their MCLs and/or deep background values.

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Two organic compounds – acetaphenone and beta-BHC – were present in surface soil above their respective screening values. There were no organic exceedances in subsurface soil. Acetaphenone was detected in only one sample (679SB00801), while beta-BHC was detected in only two. Figure 10.4.2 presents the beta-BHC concentrations detected at AOC 678/679. The limited occurrence of these compounds is indicative of very little residual mass in soil available to leach via this pathway. The sources of these compounds in soil are not likely to be directly associated with past site activities (hydrocarbon burning as part of firefighting activities). Additionally, neither of these compounds was detected in groundwater. Consequently the pathway is considered invalid with respect to organics.

Three inorganics – chromium, lead and mercury – were present in soil above their respective screening values. Both lead and mercury exhibit an increase in concentration in subsurface soil, are above the zone background in subsurface soil, and are below their SSLs in surface soil. Conversely, chromium exhibited a decrease in concentration in subsurface soil. The reason for lead and mercury to be relatively enriched with depth is unknown, ~~but would require some mobilizing agent having a relatively low pH (something not likely directly associated with site activities).~~ However, but many of the detected metals exhibited similar trends. It is both possible and probable that these trends are a result of natural variation in the site soil, which can occur in both native and non-native material. Mercury was not detected in site groundwater, whereas chromium and lead were widely detected, therefore validating the migration pathway. Figures 10.4.3, 10.4.4, and 10.4.5 present the concentrations of chromium, lead, and mercury respectively detected at AOC 6778/679. However, none of these detections were above groundwater screening values, and the pathway is not expected to be significant with respect to them.

10.4.5.2 Groundwater Migration and Surface Water Cross-Media Transport

Tables 10.4.9 and 10.4.10 compare maximum detected organic and inorganic constituent concentrations respectively in shallow groundwater samples to risk-based concentrations for

drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life

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detections of flouranthene at AOC 678/679. The Cooper River is a potential receptor, thus validating the pathway. However, the relatively low detected concentrations of flouranthene, coupled with expected dilution upon discharge to the Cooper River, suggest that the pathway is not expected to be significant.

10.4.5.3 Soil to Air Cross-Media Transport

No surface soil parameters were present above their respective screening values for the soil to air pathway, thus the pathway is considered invalid for this AOC.

10.4.5.4 Fate and Transport Summary

Acetaphenone, beta-BHC, chromium, lead, and mercury were present in soil above their respective SSLs. Neither of the organics was detected in site groundwater, thus the pathway is considered invalid with respect to them. Lead and mercury exhibited an increase in concentration with depth, a trend noted in many of the detected metals. Conversely, chromium exhibited a decrease with depth. ~~Because the site history does not include the use of potential mobilizing agents, it is expected~~ It is possible that these trends associated with depth represent natural variations within the site soil. Both lead and chromium were detected in groundwater, thus the pathway is considered valid with respect to them.

BEQs and in particular benzo(a)anthracene, were present in site groundwater at concentrations above their respective RBCs. Detection of benzo(a)anthracene was very limited, however, and it was actually nondetected during the most recent sampling round. Even though detections are not consistent in terms of frequency or concentration, the pathway is considered valid ~~but not significant due to non-ues of the resource.~~

Flouranthene was detected in two of five geoprobe groundwater samples during the fifth sampling round slightly above its surface water screening criteria. The Cooper River is a potential receptor based on groundwater flow and proximity. Therefore the pathway is considered valid ~~but given~~

~~the concentrations and the potential for natural attenuation along the flow path and dilution upon discharge, it is not significant.~~

Given the absence of surface soil exceedances for inhalation screening values, the soil to air pathway is considered invalid.

10.4.6 Human Health Risk Assessment

10.4.6.1 Site Background and Investigative Approach

The purpose of the investigation at AOC 678/679 (combined AOC 678) was the assessment of soil and groundwater potentially affected by past site activities. AOC 678 is the former firefighter school, former Building V-2, a potential site of controlled burning of ignitable materials. AOC 679 is a former wash rack location. There is no information regarding the type of structure that existed, operating practices or other activities conducted at these sites.

AOC 678 is the former site of Building 2-V, the Firefighter School, northeast of Building NS-1 in the northeastern portion of the southern peninsula. The firefighting school was reportedly constructed in 1947 and demolished circa 1955. Controlled fires may have been ignited and extinguished onsite for firefighter training. No other details regarding the design features or operating practices were available. Currently, the area is a paved parking lot.

AOC 679 consists of a former wash rack noted on early CNC maps for the 1930s and 1940s. This former wash rack was located off the west edge of Building NS-1. No information is available regarding the design features. Years of operation, or operating practices for the wash rack. It is assumed that activities at this unit included washing or cleaning of equipment in an external wash area.

The *Final Zone I RFI Work Plan* (E/A&H, February 1995) proposed three shallow monitoring wells at AOC 678/679. Subsequent to the work plan, geoprobe sample were collected to further

detections of flouranthene at AOC 678/679. The Cooper River is a potential receptor, thus validating the pathway. However, the relatively low detected concentrations of flouranthene, coupled with expected dilution upon discharge to the Cooper River, suggest that the pathway is not expected to be significant.

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COC Refinement

Further review and risk analysis will be conducted during the CMS phase of the RCRA corrective action process on the COCs identified in this RFI. This effort will be conducted to provide a check that current risk assessment guidance and procedures are being followed at the time the CMS is prepared.

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Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use of Zone I, specifically as a marine cargo terminal. If this area were to be used as a residential site, the buildings would be demolished, asphalt surface removed, and the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, exposure to conditions as represented by samples collected during the RFI would not be likely under a true future residential scenario. These factors indicate that exposure pathways assessed in this HHRA would generally overestimate the risk and hazard posed to current site workers and future site residents.

Shallow groundwater is not currently used at combined AOC 678/679 for potable or industrial purposes. A basewide system provides drinking and process water to buildings throughout Zone I. This system is slated to remain in operation under the current base reuse plan. ~~As a result, shallow groundwater would not be used under future site scenarios. Therefore, the scenario evaluated in this HHRA is highly conservative and associated pathways are not expected to be completed in the future.~~

Determination of Exposure Point Concentrations

Since less than 10 samples were collected for phorate, the maximum detected concentration was used as the EPC. The maximum concentrations of benzo(a)pyrene equivalents were used to quantify exposure using the 'hot spot' approach. The 95% UCLs of the reported soil concentrations were used as the exposure point concentrations for chromium and isodrin at this site.

Frequency of Detection and Spatial Distribution

Isodrin was the sole COC identified for surface soil. It was detected in two samples (679SB006 and 679SB007), with a maximum concentration of 1,000 µg/kg. The fraction ingested from

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10.5 AOC 680, Building NS-26 UST and Grinding Room/Brake Repair Area

AOC 680 includes Building NS-26 and associated former grinding room/brake repair area. Building NS-26 was part of the Navy's Shore Intermediate Activity (SIMA) complex. The building was constructed in 1958 and renovated in 1985. Structures associated with NS-26 include several storage sheds and steel storage trailers.

Three dip tanks were located in the west end of the facility and were used to clean ship parts. The contents of the tanks were tri-sodium phosphate, citric acid, and water. The tanks reportedly were cleaned bi-annually by CNC personnel.

An initial assessment study in 1981 noted that the following hazardous wastes were generated at this facility: boiler cleaning solution (sulfuric acid and nitric acid); cleaning solvents (chlorinated hydrocarbons); and boiler test chemicals (mercuric nitrate). From 1958 through 1981, disposal practices reportedly included discharging neutralized boiler solutions, solvents, and mercuric nitrate solutions directly into the Cooper River.

Historic information indicates that the area was used as a seaplane refueling ramp and as an oil storage area in the 1940s.

In December 1996, a 200 gallon waste oil UST located on the north side of NS-26 was closed by removal. The UST assessment report noted that the tank and associated piping was ~~severly~~severely corroded and pitted but no holes were found. The assessment report also notes that the oil-water separator associated with this UST and referenced on early building plans could not be located at the time of UST removal. ~~It is assumed that the oil-water separator has not been used since the building renovations in 1985. The waste oil tank apparently continued to be used after 1985 by pouring used oil down the pump-out piping.~~

The assessment report stated that after sample results were reviewed, the northwest end of the excavation was extended approximately 7 feet out and 8 feet below ground surface level and was discontinued because of the close proximity to sewer piping and no improvement in OVA readings. The assessment report also notes that the oil/water separator associated with this UST and referenced on early building plans could not be located at the time of UST removal. It is assumed that the oil-water separator has not been used since the building renovations in 1985. The waste oil tank apparently continued to be used after 1985 by pouring used oil down the pump-out piping.

In May 2001, a visual inspection was conducted by CH2M HILL personnel for the “missing” indoor oil/water separator. An oil/water separator was located at the northern end of the building adjacent to the parts cleaning area. Another oil/water separator was located outside on the west side of the building. In the southwest section of the building was a newly installed diesel engine testing area. The engine testing facility was never used and there was not an oil/water separator located in this area of the building. Both the UST and the oil/water separators (as auxiliary components of the UST system) will be addressed under the Navy’s Tanks Program rather than the RFI.

Materials of concern include VOCs and SVOCs. Potential receptors, include future site workers who may be involved in invasive activity that might bring them in direct contact with subsurface contaminants and hypothetical future residents. The ecology of the Cooper River is also a potential receptor.

AOC 680 initially only included the former grinding room in Building NS-26, which was reportedly used to repair brake components containing asbestos. Building plans from 1969 show

10.5 AOC 680, Building NS-26 UST and Grinding Room/Brake Repair Area

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In December 1996, a 200 gallon waste oil UST located on the north side of NS-26 was closed by removal. The UST assessment report noted that the tank and associated piping was severely corroded and pitted but no holes were found. The assessment report also notes that the oil-water separator associated with this UST and referenced on early building plans could not be located at the time of UST removal.

The assessment report stated that after sample results were reviewed, the northwest end of the excavation was extended approximately 7 feet out and 8 feet below ground surface level and was discontinued because of the close proximity to sewer piping and no improvement in OVA readings. The assessment report also notes that the oil/water separator associated with this UST and referenced on early building plans could not be located at the time of UST removal. It is assumed that the oil-water separator has not been used since the building renovations in 1985. The waste oil tank apparently continued to be used after 1985 by pouring used oil down the pump-out piping.

In May 2001, a visual inspection was conducted by CH2M HILL personnel for the “missing” indoor oil/water separator. An oil/water separator was located at the northern end of the building adjacent to the parts cleaning area. Another oil/water separator was located outside on the west side of the building. In the southwest section of the building was a newly installed diesel engine testing area. The engine testing facility was never used and there was not an oil/water separator located in this area of the building. Both the UST and the oil/water separators (as auxiliary components of the UST system) will be addressed under the Navy’s Tanks Program rather than the RFI.

Materials of concern include VOCs and SVOCs. Potential receptors, include future site workers who may be involved in invasive activity that might bring them in direct contact with subsurface contaminants and hypothetical future residents. The ecology of the Cooper River is also a potential receptor.

AOC 680 initially only included the former grinding room in Building NS-26, which was reportedly used to repair brake components containing asbestos. Building plans from 1969 show

the grinding room on the southern side of Building NS-26. Reportedly, brake repair ceased in 1970. The area once occupied by the grinding room was remodeled in 1985 and is now a short hallway to the southern entrance to the building.

Materials of concern include asbestos dust from brake repair. Air is the potential pathway of concern. Potential receptors include personnel involved with any aggressive activity that could disturb surfaces covered with asbestos.

AOC 680 is included in the northern part of Zone I, which is a fully developed coast line and not considered to be relevant to the ecological risk assessment (ERA) based on the lack of habitat and receptors. It is designated on Figure 8.2 as a "Non-Ecological Area".

To fulfill the CSI objectives and to confirm the presence of any contamination from onsite activities, soil and groundwater were sampled in accordance with the final RFI work plan and Section 3 of this report. Microvacuum samples were collected in the former grinding room to confirm the presence, if any, of asbestos fibers.

10.5.1 Soil Sampling and Analysis

Soil was sampled in two rounds at AOC 680 from the locations shown on Figure 10.5.1. The Final RFI work plan proposed collecting one geoprobe soil sample, and four soil samples from the upper- interval and four from the lower- interval. Four proposed upper- interval samples and three of the four proposed lower- interval soil samples were collected. One lower-interval sample was not collected because the water table was encountered at less than 5 bgs. All samples were submitted for analysis at DQO Level III for VOCs, SVOCs, and metals. Two samples selected as duplicates were analyzed at DQO Level IV for Appendix IX analytical parameters, which

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Table 10.5.5
 AOC 680
 Groundwater Sampling Summary

Sampling Round	Sampling Date	Number of Wells	Sample Analyses	Comments
1	03/17/98 03/18/98 04/15/98	Geoprobe ^a 3	VOCs, SVOCs VOCs, SVOCs	One shallow and one deep sample collected.
2	08/21/98	3	VOCs, SVOCs, metals	
3	10/19/98	1	VOCs, SVOCs	Installed and sampled 680004 only

Notes:

a = One shallow and one deep geoprobe sample was collected near the boundary of AOC 680 and AOC 679.

Figure 10.5.1 illustrates monitoring well locations. The shallow monitoring wells were installed at 12.5 feet bgs in the upper sand layer of the Wando Formation. The One deep monitoring point (680GP005) was advanced to a depth of approximately 22 feet bgs using DPT. However, the hole collapsed at 10 to 15 ft bgs, therefore the monitoring point was sampled only during the first round then abandoned. As a result, no permanent deep well was installed. All wells were installed in accordance with Section 3.3 of this report.

10.5.4 Nature and Extent of Contamination in Groundwater

Table 10.5.6 summarizes the organic analytical results for groundwater at AOC 680 and is non-specific with respect to location. Inorganic analytical data for shallow groundwater are summarized in Table 10.5.7. Tables 10.5.8 and 10.5.9 summarize by location all analytes detected in the shallow and deep groundwater respectively at AOC 680. Appendix D is a complete analytical report for all samples collected in Zone I. Unless a permanent monitor well is installed, samples collected byt the DPT sampling method are a one-time event and are not collected again during subsequent sampling events.

Volatile Organic Compounds in Groundwater

Eight VOCs were detected in shallow groundwater at AOC 680. Sample 680GP00501 contained acetone (6800 µg/L) and 2-butanone (MEK) (310 µg/L), which exceeded their tap-water RBCs. Tetrachloroethene (PCE) exceeded is tap-water RBC in rounds one (1.4 µg/L in

680GW00201) and two (2.0 µg/L in 680GW00202). Sample 680GW002 contained Trichloroethene (TCE)

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1	03/17/98 03/18/98 04/15/98	Geoprobe ^a 3	VOCs, SVOCs VOCs, SVOCs	One shallow and one deep sample collected.
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10.6 AOC 681, Building 681 Blast Booth

AOC 681 is the abrasive blast booth on the west side of Building 681 used for stripping miscellaneous ship and boiler components. The blasting agent (aluminum oxide) is recycled through a cyclone separator and the generated wastes, primarily paint dust, are directed into an outdoor hopper and then into 55-gallon drums for disposal.

Building 681 was constructed in 1984⁵ to serve as a shop and administration building for Shore Intermediate Maintenance Activity (SIMA). The facility contained a hose shop; a canvas shop; a tool storage area; a valve shop; a lagging shop; an air conditioning and recovery shop; a hydraulics shop; a paint booth; a blasting booth; a pump shop; a machine shop; an electrical shop; and a varnish dip tank. The facility is currently used as a vessel support facility for the U.S. Coast Guard.

An aboveground storage tank existed within the foot print of Building 681 (Figure 10.6.1) but was removed some time prior to construction of the building. Review of available site documentation did not provide any historical information relative to an aboveground tank in this area. (DANIELSEN 6/30/99 Comment 26)

Two underground storage tanks (681-1 and 681-2) were associated with this facility. The tanks were installed in 1985, when the facility was constructed. Both tanks were closed by removal in early 1997.

UST 681-1 was an unregulated 100 gallon waste oil tank located on the southeast side of Building 681 and -

UST 681-2 was an unregulated 20,000 gallon fuel oil tank located on the south side of Building 681. It stored fuel oil for boilers located in Buildings 681 and 680. Both tanks were closed in 1997 and in a letter dated November 12, 1997, SCDHEC noted "results would appear to indicate that no

additional endeavors for remedial actions and contaminant characterization are warranted at this time.” (DANIELSEN 6/30/99 Comment 26)

Building 680, which is located on the west side of Building 681, was constructed in 1975 and is used for maintenance activities similar to those conducted in Building 681. Engine parts and other equipment are cleaned in dip tanks and/or are sandblasted clean as part of repair and maintenance programs.

AOC 681 is included in the northern part of Zone I, which is a fully developed coastline and not considered relevant to the ecological risk assessment (ERA) based on lack of habitat and receptors. It is designated on Figure 8.2 as a “Non-Ecological Area”. (BYRD 6/30/99 General Comment 2)

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In addition, a sanitary and industrial sewer system site plan map from 1968 indicates that an oil/water separator and associated UST was located just at the northeast corner of what is now Building 681.

Materials of concern are lead-based paint and aluminum oxide in the blast booth area and solvents and petroleum products associated with the maintenance activities. Potential receptors include current or future site workers involved in invasive activities or working in or near the blast booth.

Average particulate air emissions from the booth are 0.0004 pounds per hour or 0.00175 tons per year (*Final Zone I RFI Work Plan*, E/A&H, February 1995).

To fulfill RFI objectives, soil, groundwater, and dust were sampled in accordance with the *Final Zone I RFI Work Plan*, (E/A&H, February 1995), and Section 3 of this report. Sampling was conducted to confirm the presence of any contamination from the onsite activities.

10.6.1 Soil Sampling and Analysis

Soil was sampled in four rounds in the area around AOC 681 and from area surrounding grid-based wells GDI013 and GDI13D. These locations shown on Figure 10.6.1. The *Final Zone I RFI Work Plan* (E/A&H, February 1995) proposed three soil samples collected from the upper interval and three from the lower interval. During the first round of soil sampling, three samples were collected from the upper interval and two samples were collected from the lower interval. The third proposed lower interval sample was not collected due to a water table less than 5 feet bgs; saturated samples were not submitted for analysis. Samples were analyzed for organotins and the standard suite of chemicals, which includes VOCs, SVOCs, metals, cyanide,

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Sample 681SB00501 was collected during second-round sampling after an empty oil/water separator line was breached while coring through asphalt to collect soil samples. This sample was analyzed for pesticides, SVOCs, TPH, and VOCs to determine the extent, if any, of a release. Analytical results indicate no impact occurred as a result of the line breach. Metals were not included in the analytical suite because the purpose of the sample was simply to confirm that no oil had been released into the surrounding soil. If no oil was released, then it is reasonable to assume that no metals were released either.

A third-round of geoprobe soil sampling was conducted in the area surrounding GDI013 after VOCs and SVOCs were detected in groundwater samples collected at this grid-based well location, which is adjacent to AOC 681. Soil samples originally collected from the location of GDI013 boring did not indicate elevated concentrations of VOCs and SVOCs, however, additional soil samples were collected from the area while groundwater samples were being collected with a geoprobe sampler. Three upper and three lower interval soil samples were collected using a geoprobe sampler (DPT) and analyzed for VOCs and SVOCs. Duplicate samples were not collected during this sampling event.

A fourth round of soil sampling was conducted as a result of new information that indicated the presence of former oil/water separators and USTs on the north and east side of Building 681. Additional samples were also collected in the area between Buildings 680 and 681 to further delineate the extent of contamination. Six upper level and five lower level samples were collected. These samples were analyzed for VOCs, SVOCs, metals, cyanide, pesticides and PCBs.

Grid-based soil-boring (GDISB013) was drilled in the area of AOC 681 as noted in Figure 10.6.1. Upper and lower interval samples from this boring were analyzed for the Standard Suite of

parameters. Results of these analyses are presented in the Nature and Extent of Contamination discussion. Appendix D contains the complete analytical data report.

In addition to the samples collected as part of the RFI effort, the Environmental Detachment Charleston (DET) was tasked with collecting additional surface soil samples adjacent to and inside Building 681. The DET collected six surface soil samples, two outside and four inside Building 681 in May, 1999.

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10.6.2 Nature and Extent of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.6.2. Inorganic analytical results for soil are summarized in Table 10.6.3. Table 10.6.4 summarizes all analytes detected in soil at AOC 681. Appendix D contains complete analytical data report for all samples collected in Zone I, including the data on samples collected by the DET.

Table 10.6.2
 AOC 681
 Organic Compound Analytical Results for Soil (µg/kg)

Compound	Sampling Interval	Frequency of Detection	Range of Detection	Mean	RBC (Upper) SSL (Lower)	Number of Samples Exceeding RBC or SSL
Volatile Organics						
Acetone	Upper	2/14	12 - 48	30	780,000	0
	Lower	5/9	7 - 54	27.6	8,000	0
Carbon Disulfide	Upper	1/17	1	1	780,000	0
	Lower	0/6	ND	ND	16,000	0
Toluene	Upper	3/14	2	2	1,600,000	0
	Lower	1/9	2	2	6,000	0
Xylene	Upper	1/14	3.3	3.3	16,000,000	0
	Lower	2/9	2.6 - 3.6	3.1	70,000	0
Semivolatile Organics						
Acenaphthene	Upper	1/14	140	140	470,000	0
	Lower	2/9	330 - 3,800	2,065	290,000	0
Acetophenone	Upper	0/14	ND	ND	780,000	0
	Lower	1/9	41	41	0.12	1
Anthracene	Upper	1/14	640	640	2,300,000	0
	Lower	1/9	4,900	4,900	5,900,000	0
Benzo(g,h,i)perylene	Upper	1/14	850	850	310,000	0
	Lower	1/9	3,800	3,800	1.2E+8	0
BEQ*	Upper	4/14	69.2 - 3,445	945	87	3

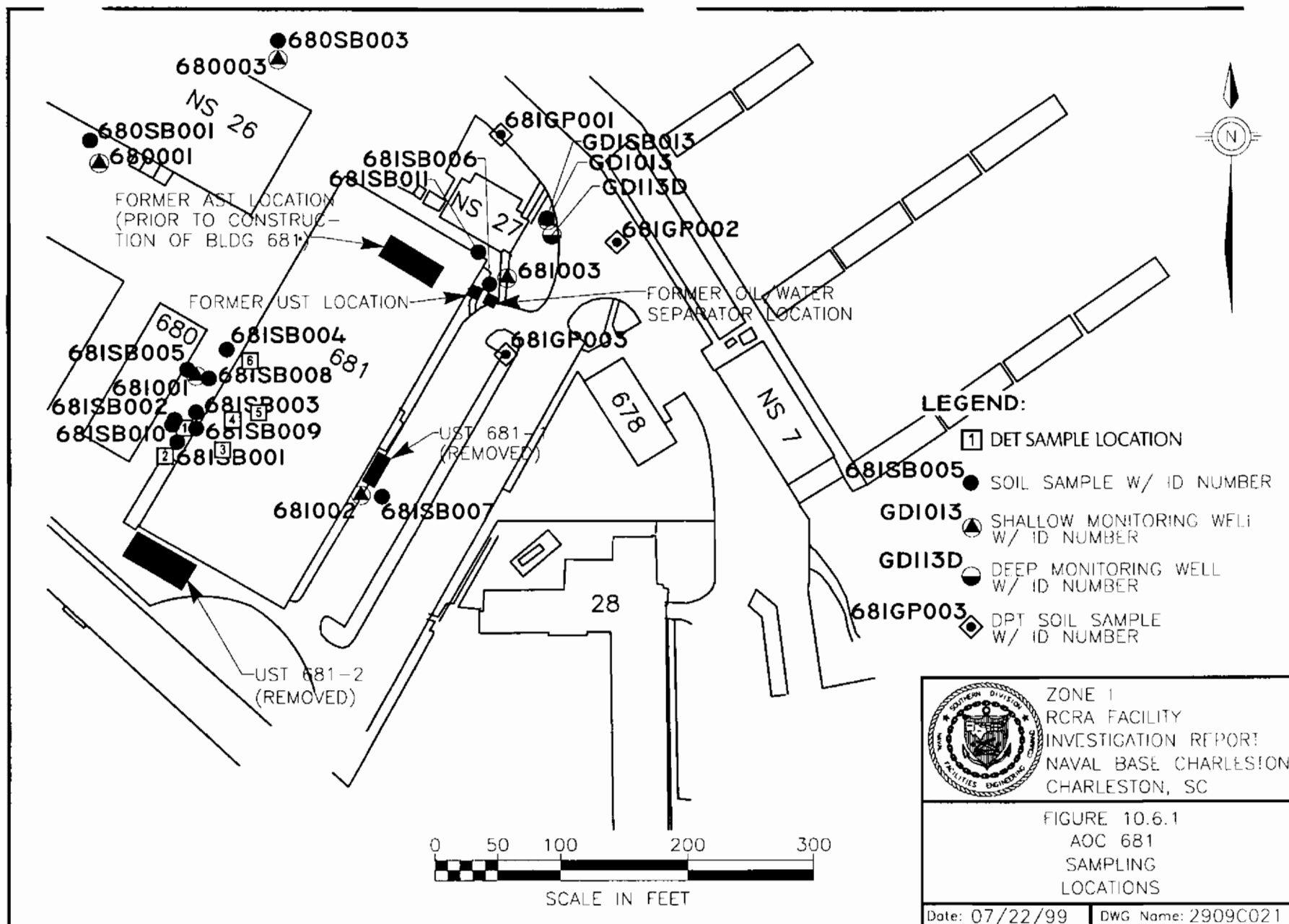
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Toluene	Upper	3/14	2	2	1,600,000	0
	Lower	1/9	2	2	6,000	0
Xylene	Upper	1/14	3.3	3.3	16,000,000	0
	Lower	2/9	2.6 - 3.6	3.1	70,000	0
Semivolatile Organics						
Acenaphthene	Upper	1/14	140	140	470,000	0
	Lower	2/9	330 - 3,800	2,065	290,000	0
Acetophenone	Upper	0/14	ND	ND	780,000	0
	Lower	1/9	41	41	0.12	1
Anthracene	Upper	1/14	640	640	2,300,000	0
	Lower	1/9	4,900	4,900	5,900,000	0
Benzo(g,h,i)perylene	Upper	1/14	850	850	310,000	0
	Lower	1/9	3,800	3,800	1.2E+8	0
BEQ*	Upper	4/14	69.2 - 3,445	945	87	3



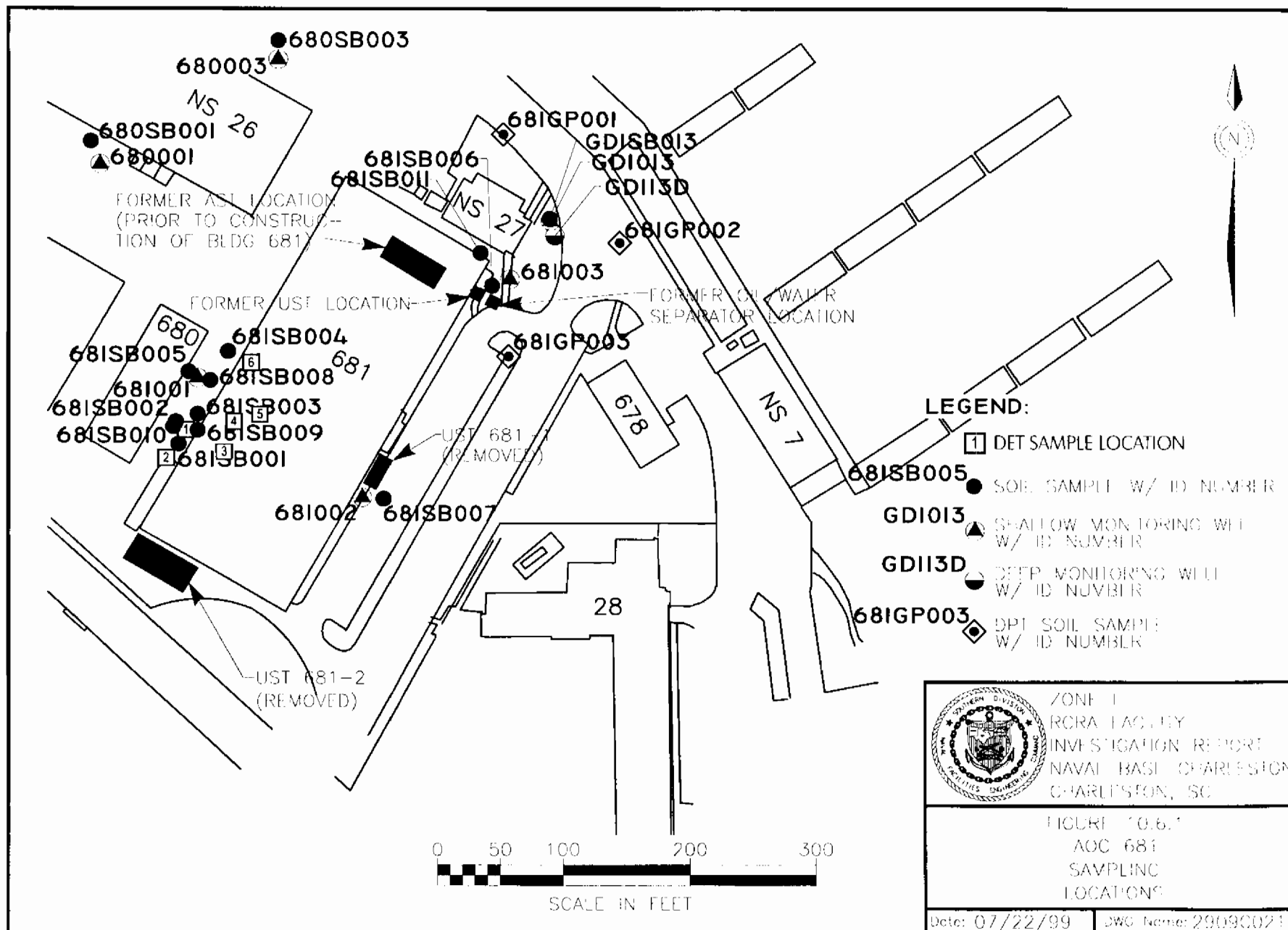


Table 10.6.4a
Detachment Confirmation Sampling for BEQs in Soil
AOC 681, Charleston Naval Complex
Charleston, South Carolina

Parameter	SAMPLE											
	99SPORT0196-01		99SPORT0196-02		99SPORT0196-03		99SPORT0196-04		99SPORT0196-05		99SPORT0196-06	
	Result ug/kg	Qual (1)	Result ug/kg	Qual (1)	Result ug/kg	Qual (1)	Result ug/kg	Qual (1)	Result ug/kg	Qual (1)	Result ug/kg	Qual (1)
Acenaphthene	3.32	U	3.32	U	13.3	U	13.3	U	13.3	U	3.32	U
Acenaphthylene	3.32	U	3.32	U	13.3	U	13.3	U	13.3	U	3.32	U
Anthracene	3.32	U	3.32	U	13.3	U	13.3	U	13.3	U	3.32	U
Benzo(a)anthracene	57.2		3.32	U	81.6		13.3	U	13.3	U	3.32	U
Benzo(a)pyrene	57		17.5		78.1		13.3	U	13.3	U	3.32	U
Benzo(b)fluoranthene	142		20		74.7		13.3	U	13.3	U	3.32	U
Benzo(ghi)perylene	37.2		3.32	U	13.3	U	13.3	U	13.3	U	3.32	U
Benzo(k)fluoranthene	3.32	U	17		99.2		13.3	U	13.3	U	3.32	U
Chrysene	74.5		17.4		152.0		13.3	U	13.3	U	3.32	U
Dibenzo(a,h)anthracene	13.3	U	13.3	U	53.0	U	53	U	53	U	13.3	U
Fluoranthene	116		19.9		13.3	U	13.3	U	13.3	U	3.32	U
Fluorene	3.32	U	3.32	U	13.3	U	13.3	U	13.3	U	3.32	U
Indeno(1,2,3-c,d)pyrene	26.5		11.6	U	46.5	U	46.5	U	46.5	U	11.6	U
Naphthalene	3.32	U	3.32	U	13.3	U	13.3	U	13.3	U	3.32	U
Phenanthrene	27.5		3.32	U	13.3	U	13.3	U	13.3	U	3.32	U
Pyrene	116		25.6		13.3	U	13.3	U	13.3	U	3.32	U
BEQs (2)	93		34		153		ND		ND		ND	

(1) For non-detect samples (U), the value in the result column is one-half the detection limit. This value was used in the BEQ calculation.

(2) BEQs are benzo(a)pyrene equivalents. BEQs were derived as follows:

The concentration for each carcinogenic PAH was adjusted by the Toxicity Equivalency Factor (TEF - see below) and the results were summed.

<u>Carcinogenic PAH</u>	<u>TEF</u>
Benzo(a)anthracene	0.1
Benzo(a)pyrene	1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1
Indeno(1,2,3-c,d)pyrene	0.1

Volatile Organic Compounds in Soil

No VOCs were detected in soil samples at AOC 681 above their respective RBCs or SSLs. Two VOCs were detected in soil samples collected at grid-based well GDI013, however, they did not exceed their respective SSLs.

Semivolatile Organic Compounds in Soil

Twenty-one SVOCs were detected in AOC 681 surface soil samples. The following PAHs exceeded their respective RBCs: benzo(a)anthracene (2,900 $\mu\text{g/kg}$), benzo(a)pyrene (2,300 $\mu\text{g/kg}$), benzo(b)fluoranthene (2,700 $\mu\text{g/kg}$), dibenzo(a,h)anthracene (407 $\mu\text{g/kg}$), and indeno(1,2,3-cd)pyrene (880 $\mu\text{g/kg}$). Each of these exceedances occurred at boring 681SB00901. No other SVOCs exceeded their RBC in the surface soil samples and no SVOCs were detected in grid boring GDI013. Ten SVOCs were detected in the DET suite of surface soil samples. None of the PAHs exceeded their respective RBCs.

Twenty-four SVOCs were detected in subsurface soil samples. Again, only PAHs exceeded their respective SSLs. Benzo(a)anthracene (18,000 $\mu\text{g/kg}$), benzo(a)pyrene (11,000 $\mu\text{g/kg}$), benzo(b)fluoranthene (20,000 $\mu\text{g/kg}$), benzo(k)fluoranthene (22,000 $\mu\text{g/kg}$), and dibenzo(a,h)anthracene (1,300 $\mu\text{g/kg}$), all in boring 681SB00102. No other subsurface SVOCs exceeded their SSL.

In accordance with recent cPAH guidance (USEPA *Interim Supplemental Guidance to RAGS: Region IV Bulletins, Human Health Risk Assessment*, Bulletin No. 2 [USEPA, 1995c]) and Section 7 of this report, BEQs were calculated for cPAHs at AOC 681. The BEQ for sample 681SB00101 is 102 $\mu\text{g/kg}$, 681SB00201 is 69.2 $\mu\text{g/kg}$, 681SB00301 is 164 $\mu\text{g/kg}$, and 681SB00901 is 3,445 $\mu\text{g/kg}$. Three samples exceed the RBC of 87 $\mu\text{g/kg}$. The BEQ for 681SB00102 is 16,783 $\mu\text{g/kg}$, which exceeds the SSL of 1,600 $\mu\text{g/kg}$. These detections are concentrated in the area between Buildings 680 and 681.

Volatile Organic Compounds in Soil

No VOCs were detected in soil samples at AOC 681 above their respective RBCs or SSLs. Two VOCs were detected in soil samples collected at grid-based well GDI013, however, they did not exceed their respective SSLs.

Semivolatile Organic Compounds in Soil

Twenty-one SVOCs were detected in AOC 681 surface soil samples. The following PAHs exceeded their respective RBCs: benzo(a)anthracene (2,900 $\mu\text{g/kg}$), benzo(a)pyrene (2,300 $\mu\text{g/kg}$), benzo(b)fluoranthene (2,700 $\mu\text{g/kg}$), dibenzo(a,h)anthracene (407 $\mu\text{g/kg}$), and indeno(1,2,3-cd)pyrene (880 $\mu\text{g/kg}$). Each of these exceedances occurred at boring 681SB00901. No other SVOCs exceeded their RBC in the surface soil samples and no SVOCs were detected in grid boring GDI013. Ten SVOCs were detected in the DET suite of surface soil samples. None of the PAHs exceeded their respective RBCs.

Twenty-four SVOCs were detected in subsurface soil samples. Again, only PAHs exceeded their respective SSLs. Benzo(a)anthracene (18,000 $\mu\text{g/kg}$), benzo(a)pyrene (11,000 $\mu\text{g/kg}$), benzo(b)fluoranthene (20,000 $\mu\text{g/kg}$), benzo(k)fluoranthene (22,000 $\mu\text{g/kg}$), and dibenzo(a,h)anthracene (1,300 $\mu\text{g/kg}$), all in boring 681SB00102. No other subsurface SVOCs exceeded their SSL.

In accordance with recent cPAH guidance (USEPA *Interim Supplemental Guidance to RAGS: Region IV Bulletins, Human Health Risk Assessment*, Bulletin No. 2 [USEPA, 1995c]) and Section 7 of this report, BEQs were calculated for cPAHs at AOC 681. The BEQ for sample 681SB00101 is 102 $\mu\text{g/kg}$, 681SB00201 is 69.2 $\mu\text{g/kg}$, 681SB00301 is 164 $\mu\text{g/kg}$, and 681SB00901 is 3,445 $\mu\text{g/kg}$. Three samples exceed the RBC of 87 $\mu\text{g/kg}$. The BEQ for 681SB00102 is 16,783 $\mu\text{g/kg}$, which exceeds the SSL of 1,600 $\mu\text{g/kg}$. These detections are concentrated in the area between Buildings 680 and 681.

The DET collected six additional surface soil samples adjacent to and/or inside Building 681 in the vicinity of boring 681SB009. A copy of the DET sampling report has been included in Appendix I of this report. The samples were analyzed for SVOCs only (due to the levels of PAHs detected in 681SB009). The calculated BEQs for these six samples ranged from ND to 94.9 $\mu\text{g/kg}$ (which exceeds the RBC of 87 $\mu\text{g/kg}$) beneath Building 681. This indicates that the contamination extends under the building on the southwest corner.

Pesticides and PCBs in Soil

Seventeen pesticides were detected in surface soils at AOC 681. No detections exceeded their RBC. Seven pesticides were detected in subsurface soil samples. None exceeded their SSL. Three pesticides were detected in soil samples collected at grid-based well GDI013, however, none of these exceeded their respective RBCs.

Other Organic Compounds in Soil

Dioxins and furans were detected in the duplicate sample collected at boring 681SB004. In accordance with recent dioxin guidance and Section 7 of this report, TEQs were calculated. The TEQ for 681SB00401 is 3.20E-4 $\mu\text{g/kg}$, which is well below the RBC of 4,300 $\mu\text{g/kg}$.

TPH was detected at 150 mg/kg in sample 681SB00501.

Inorganic Elements in Soil

Seventeen metals were detected in surface soil samples at AOC 681. Only one sample exceeded its RBC and background. Chromium (total) was detected at 73.5 $\mu\text{g/kg}$ in sample 681SB01101. Eleven metals were detected in Grid boring GDISB01301. None exceeded their respective RBC and background values.

Sampling By Others

The DET collected six additional surface soil samples adjacent to and/or inside Building 681 in the vicinity of boring 681SB009. The additional DET samples were collected to delineate the high PAHs levels initially encountered in boring 681SB009. A copy of the DET sampling report ~~is has~~ been included as ~~an a~~ Attachment I ~~to this report~~. The samples were analyzed for SVOCs only (due to the levels of PAHs detected in 681SB009). The calculated BEQs for these six samples ranged from ND to 94.9 $\mu\text{g/kg}$ (which exceeds the RBC of 87 $\mu\text{g/kg}$) beneath Building 681 (Table 10.6.4a). This indicates that the contamination extends under the building on the southwest corner. The analytical results in the DET borings SB-4 through SB-6 were below analytical detection limits which delineates the contamination around 681SB009.

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Seventeen pesticides were detected in surface soils at AOC 681. No detections exceeded their RBC.

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One inorganic — chromium — was present in soil above its screening value. It was present in both surface and subsurface soil samples. It was only detected in groundwater in the grid-base well location (both shallow and deep samples). Figure 10.6.4 presents the chromium concentrations detected at AOC 681. The presence of chromium in soil is potentially consistent with past activities at Buildings 680 and 681 (maintenance shop) and the presence of chromium in soil and groundwater validates the pathway with respect to this parameter.

10.6.5.2 Groundwater Migration to Surface Water Cross Media Transport

Tables 10.6.11 and 10.6.12 compare maximum detected organic and inorganic constituent concentrations respectively, in shallow groundwater to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are screened against the greater of (a) risk-based drinking water concentrations or (b) corresponding background concentrations for groundwater, as well as to the saltwater surface water chronic values. To provide a conservative screening, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards. ~~It should be noted at the beginning of this discussion that the risk-based pathway for shallow groundwater is currently an invalid pathway simply because there is no human consumption of the groundwater, e.g. there is no end use receptor.~~ This comparison is made for screening only, and to develop strategies for long-term management of the groundwater should an area containing deleterious levels be identified.

Two semi-volatile compounds — acenaphthene and bis(2-ethylhexyl)phthalate (BEHP) were present in groundwater at concentrations that exceeded their respective screening values. Both exhibited only slight exceedances. Acenaphthene was only detected in one geoprobe sample and BEHP was only detected above the screening value in one well in the second round. The inconsistent detections of acenaphthene would indicate that the pathway is not considered valid

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with respect to this constituent. The presence of BEHP is suspect (it is often a common laboratory artifact) and due to its absence in the most recent round of groundwater sampling as well as its absence from groundwater samples collected from the grid-based shallow well, the pathway for this constituent is considered invalid. Figure 10.6.5 presents concentrations of BEHP detected at AOC 681.

Three inorganic constituents — copper, mercury, and silver — were present in groundwater at levels above their respective screening values for surface water migration. Copper was detected at approximately twice its background for shallow groundwater, but was not above its SSL in surface or subsurface soil. Figure 10.6.6 presents concentrations of copper detected at AOC 681. Mercury was detected above its screening value for surface water migration but was only detected in the third round of sampling and was not detected in the grid-based well. Mercury detections were also below SSLs for surface and subsurface soil. Silver was only detected in one well in the first and third round of sampling and was not detected in the grid-based well. Additionally, silver was not detected in the soil samples collected at this site. The proximity of the Cooper River and the groundwater flow direction indicate that the river is a potential receptor of groundwater discharge, ~~but attenuation along the flowpath and dilution upon discharge to the river will likely reduce concentrations of these constituents to insignificant levels.~~

10.6.5.3 Soil to Air Cross-Media Transport

No surface soil parameters were present above their respective screening values for the soil to air pathway, thus the pathway is considered invalid for this AOC.

10.6.5.4 Fate and Transport Summary

Acetophenone and BEQs were present in soil above their respective SSLs. Acetophenone was only detected in on of six subsurface soil samples and was not detected in any surface soil

samples. There were no corresponding detections of this compound in the groundwater samples.

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Three inorganic constituents — copper, mercury, and silver — were present in groundwater at levels above their respective screening values for surface water migration. Copper was detected at approximately twice its background for shallow groundwater, but was not above its SSL in surface or subsurface soil. Figure 10.6.6 presents concentrations of copper detected at AOC 681. Mercury was detected above its screening value for surface water migration but was only detected in the third round of sampling and was not detected in the grid-based well. Mercury detections were also below SSLs for surface and subsurface soil. Silver was only detected in one well in the first and third round of sampling and was not detected in the grid-based well. Additionally, silver was not detected in the soil samples collected at this site. The proximity of the Cooper River and the groundwater flow direction indicate that the river is a potential receptor of groundwater discharge.

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indicating that this lone detection may be an anomaly and the soil-to-groundwater pathway for this compound is not considered valid. BEQs were detected in both the surface and subsurface soil samples in an area between Buildings 680 and 681. However, there were no detections of BEQs in the shallow groundwater samples at the site. The absence of any BEQs in the shallow groundwater in this area indicates that the pathway may not be valid.

Acenaphthene and BEHP were present in groundwater at concentrations that exceeded their respective screening values. Both exhibited only slight exceedances. Acenaphthene was only detected in one geoprobe sample and BEHP was only detected above the screening value in one well in the second round. The inconsistent detections and the fact that these constituents were not detected in the most recent sampling round would invalidate the pathway.

Copper, mercury, and silver were present in groundwater at levels above their respective screening values for surface water migration. Copper was detected at approximately twice its background for shallow groundwater, but was not above its SSL in surface or subsurface soil. Mercury was detected above its screening value for surface water migration but was only detected in the third round of sampling and was not detected in the grid-based well. Mercury detections were also below SSLs for surface and subsurface soil. Silver was only detected in one well in the first and third round of sampling and was not detected in the grid-based well. Additionally, silver was not detected in the soil samples collected at this site. The proximity of the Cooper River and the groundwater flow direction indicate that the river is a potential receptor of groundwater discharge, but attenuation along the flowpath and dilution upon discharge to the river will likely reduce concentrations of these constituents to insignificant levels.

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Groundwater

The same conservative screening process used for soil is also used for groundwater. Of the CPSSs screened and eliminated from formal assessment, none were reported at a concentration close to its corresponding RBC (e.g. within 10% of their RBCs). Arsenic, manganese, and thallium were detected at concentrations exceeding their tap water RBCs, however, their maximum concentrations did not exceed their corresponding background concentrations. As a result, each chemical was eliminated from consideration in the risk assessment.

Groundwater is not currently used as a potable water source at AOC 681, nor is it used in the surrounding area. Municipal water is readily available. ~~As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.~~

Background — Related Risk

Soil

Aluminum, arsenic, and manganese were detected in AOC 681 surface soil at concentrations above their respective RBCs. These elements were eliminated from consideration in the risk assessment based on comparison to corresponding background values. It is not unusual for naturally occurring or background concentrations of some elements to exceed risk-based concentrations. It is the risk assessments function to identify excess risk and/or hazard, or that which is above background levels. The following is a discussion of the residential scenario risk/hazard associated with background concentrations of aluminum, arsenic, and manganese.

The maximum surface soil concentration of aluminum (11900 mg/kg) for AOC 681 equates with HQs of 0.16 and 0.008 for the residential child and site worker, respectively. The background

value for aluminum (27,400 mg/kg) resulted in HQs of 0.38 and 0.02 for the residential child and

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sampling was also performed with 21 upper and 18 lower samples taken and analyzed for metals and SVOCs analyses. Three third sound samples were duplicated and submitted for metals and SVOC analysis.

No groundwater sampling was performed in conjunction with the AOC 685 RFI.

10.7.6.2 COPC Identification

Soil

Based on the screening comparisons described in Section 7 of this RFI and presented in Table 10.7.7, the following COPCs were identified: benzo(a)pyrene equivalents, aluminum, antimony, arsenic, chromium, copper, lead, manganese, and thallium. Vanadium was identified as a COPC based on the results of Wilcoxon rank sum test analyses.

10.7.6.3 Exposure Assessment

Exposure Setting

AOC 685 is a former smoke drum site. No base operations are currently conducted at AOC 685. This area is slated to be maintained as an undeveloped open buffer area, according to current base reuse plans. Groundwater is not currently used ~~the future~~ as potable or process water, nor is such use anticipated in the future.

Potentially Exposed Populations

Potentially exposed populations are current and future site workers, hypothetical future site residents, and adolescent trespassers. Future site resident and worker exposure scenarios were addressed quantitatively in this risk assessment. The future site resident scenario was built on the premise that existing features would be removed and replaced with dwellings. The resident child scenario was considered to be conservatively representative of the adolescent trespasser.

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Table 10.8.7
AOC 687 and SWMU 16
Inorganic Analytical Results for Groundwater (µg/L)

Parameters	Sample Round	Detection Frequency	Detection Range	Mean	Tap-water RBC/MCL	Shallow Groundwater Background	Number of Samples Exceeding lower of the RBC or MCL, and Background
Aluminum (Al)	First	0/4	ND	ND	3,700/NL	1,440	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	1/4	209	209			0
	Fifth	3/4	300 - 1,000	537			0
	Sixth	0/4	ND	ND			0
Antimony (Sb)	Seventh	0/6	ND	ND			0
Arsenic (As)	First	3/4	6.3 - 38.6	26.0	0.045/50	23	2
	Second	1/4	ND - 73.7	73.7			1
	Third	1/4	5.6	5.6			0
	Fourth	1/4	39.3	39.3			1
	Fifth	3/4	4.1 - 131	47.8			1
	Sixth	4/4	3.3 - 58.3	17.3			1
	Seventh	3/6	3.4 - 26.70	11.4			1
Barium (Ba)	First	0/4	ND	ND	260/2,000	110	0
	Second	4/4	16.6 - 22.2	19.7			0
	Third	0/4	ND	ND			0
	Fourth	4/4	13.0 - 20.8	16.0			0
	Fifth	3/4	17.7 - 25.1	21.1			0
	Sixth	4/4	22.3 - 49.3	34.8			0
Beryllium (Be)	First	0/4	ND	ND	7.3/4	1.1	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	4/4	0.33 - 0.4	0.38			0
	Fifth	0/4	ND	ND			0
	Sixth	1/4	0.30	0.30			0
Calcium (Ca)	First	4/4	164,000 - 235,000	208,000	NL/NL	NL	NA
	Second	4/4	201,000 - 264,000	226,000			NA
	Third	4/4	193,000 - 276,000	225,000			NA
	Fourth	4/4	199,000 - 309,000	242,000			NA
	Fifth	4/4	193,000 - 254,000	216,000			NA
	Sixth	4/4	236,000 - 449,000	317,000			NA
Chromium (Cr)	First	3/4	1.5 - 4.6	2.7	18/100	14.3	0
	Second	0/4	ND	ND			0
	Third	1/4	1.7	1.7			0
	Fourth	0/4	ND	ND			0
	Fifth	0/4	ND	ND			0
	Sixth	4/4	12.7 - 26.1	20.1			3
Cobalt (Co)	First	0/4	ND	ND	220/NL	2.2	0
	Second	1/4	3.1	3.1			0
	Third	0/4	ND	ND			0
	Fourth	0/4	ND	ND			0
	Fifth	2/4	1.3 - 1.9	1.6			0
	Sixth	3/4	4.0 - 4.7	4.33			0

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Copper (Cu)	First	0/4	ND	ND	150/1,300	4.4	0
	Second	1/1	2.1	2.1			0
	Third	0/4	ND	ND			0
	Fourth	2/4	11.4 - 12.3	11.9			0
	Fifth	1/4	29.3	29.3			0
	Sixth	4/4	3.4 - 16.9	10.2			0
Iron (Fe)	First	4/4	2,480 - 4,420	3,390	NL/NL	NL	NA
	Second	4/4	879 - 8,570	3,840			NA
	Third	2/4	1,740 - 3,490	2,620			NA
	Fourth	3/4	211 - 3,950	1,780			NA
	Fifth	4/4	542 - 13,700	5,830			NA
	Sixth	4/4	795 - 4,420	2,429			NA
Lead (Pb)	First	3/4	2.1 - 4.0	2.9	15/15	4.4	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	0/4	ND	ND			0
	Fifth	0/4	ND	ND			0
	Sixth	0/4	ND	ND			0
	Seventh	0/6	ND	ND			0
Magnesium (Mg)	First	4/4	111,000 - 140,000	123,000	NL/NL	NL	NA
	Second	4/4	89,500 - 120,000	101,000			NA
	Third	4/4	108,000 - 171,000	126,000			NA
	Fourth	4/4	59,900 - 92,800	78,400			NA
	Fifth	4/4	57,100 - 257,000	120,000			NA
	Sixth	4/4	91,000 - 160,000	125,075			NA
Manganese (Mn)	First	4/4	165 - 1,330	735	73/NL	5,430	0
	Second	4/4	327 - 3,290	1,660			0
	Third	2/4	215 - 1,750	983			0
	Fourth	4/4	43.5 - 134	94.6			0
	Fifth	4/4	280 - 2,220	1,020			0
	Sixth	4/4	223 - 2,820	1,046			0
Nickel (Ni)	First	4/4	2.0 - 23.9	11.9	73/100	13.3	0
	Second	3/4	1.5 - 24	9.9			0
	Third	2/4	1.1 - 2.0	1.6			0
	Fourth	2/4	11.1 - 15.7	13.4			0
	Fifth	1/4	19.3	19.3			0
	Sixth	4/4	6.5 - 23.9	11.6			0
Potassium (K)	First	4/4	60,300 - 105,000	76,100	NL/NL	NL	NA
	Second	4/4	35,600 - 45,200	41,600			NA
	Third	4/4	39,400 - 56,800	46,800			NA
	Fourth	4/4	23,300 - 42,500	34,900			NA
	Fifth	4/4	28,400 - 86,800	48,000			NA
	Sixth	4/4	38,300 - 64,700	50,500			NA
Selenium (Se)	First	0/4	ND	ND	18/50	ND	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	4/4	3.4 - 8.5	5.0			0
	Fifth	0/4	ND	ND			0
	Sixth	1/4	0.93	0.93			0

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Sodium (Na)	First	4/4	375,000 - 895,000	541,000	NL/NL	NL	NA
	Second	4/4	389,000 - 509,000	453,000			NA
	Third	4/4	470,000 - 945,000	644,000			NA
	Fourth	4/4	1,980 - 361,000	170,000			NA
	Fifth	4/4	192,000 - 1,390,000	553,000			NA
	Sixth	4/4	296,000 - 674,000	465,750			NA
Tin (Sn)	First	4/4	104 - 221	177	2,200/NL	NA	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	0/4	ND	ND			0
	Fifth	0/4	ND	ND			0
	Sixth	0/4	ND	ND			0
Thallium (Tl)	First	0/4	ND	ND	0.26/2	2.0	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	2/4	2.7 - 5.2	4.0			2
	Fifth	0/4	ND	ND			0
	Sixth	0/4	ND	ND			0
	Seventh	0/4	ND	ND			0
Vanadium (V)	First	0/4	ND	ND	26/NL	14	0
	Second	4/4	1.0 - 1.8	1.2			0
	Third	0/4	ND	ND			0
	Fourth	2/4	5.7 - 6.2	6.0			0
	Fifth	0/4	ND	ND			0
	Sixth	4/4	3.1 - 5.0	3.95			0
Zinc (Zn)	First	4/4	23.3 - 41.4	33.8	1,100/NL	24.4	0
	Second	2/4	4.5 - 8.1	6.3			0
	Third	1/4	29.7	29.7			0
	Fourth	2/4	6.4 - 8.4	7.4			0
	Fifth	1/4	14.6	14.6			0
	Sixth	4/4	9.1 - 23.4	16.1			0

Notes:

NA = Not Applicable/Not Available

ND = Not Detected/Not Determined

NL = Not Listed

µg/L = Micrograms per liter

See Table 5.6 for inorganic screening concentrations and their sources.

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Table 10.8.7
AOC 687 and SWMU 16
Inorganic Analytical Results for Groundwater (µg/L)

Parameters	Sample Round	Detection Frequency	Detection Range	Mean	Tap-water RBC/MCL	Shallow Groundwater Background	Number of Samples Exceeding lower of the RBC or MCL, and Background
Aluminum (Al)	First	0/4	ND	ND	3,700/NL	1,440	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	1/4	209	209			0
	Fifth	3/4	300 - 1,000	537			0
	Sixth	0/4	ND	ND			0
Antimony (Sb)	Seventh	0/6	ND	ND			0
Arsenic (As)	First	3/4	6.3 - 38.6	26.0	0.045/50	23	2
	Second	1/4	ND - 73.7	73.7			1
	Third	1/4	5.6	5.6			0
	Fourth	1/4	39.3	39.3			1
	Fifth	3/4	4.1 - 131	47.8			1
	Sixth	4/4	3.3 - 58.3	17.3			1
	Seventh	3/6	3.4 - 26.70	11.4			1
Barium (Ba)	First	0/4	ND	ND	260/2,000	110	0
	Second	4/4	16.6 - 22.2	19.7			0
	Third	0/4	ND	ND			0
	Fourth	4/4	13.0 - 20.8	16.0			0
	Fifth	3/4	17.7 - 25.1	21.1			0
	Sixth	4/4	22.3 - 49.3	34.8			0
Beryllium (Be)	First	0/4	ND	ND	7.3/4	1.1	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	4/4	0.33 - 0.4	0.38			0
	Fifth	0/4	ND	ND			0
	Sixth	1/4	0.30	0.30			0
Calcium (Ca)	First	4/4	164,000 - 235,000	208,000	NL/NL	NL	NA
	Second	4/4	201,000 - 264,000	226,000			NA
	Third	4/4	193,000 - 276,000	225,000			NA
	Fourth	4/4	199,000 - 309,000	242,000			NA
	Fifth	4/4	193,000 - 254,000	216,000			NA
	Sixth	4/4	236,000 - 449,000	317,000			NA
Chromium (Cr)	First	3/4	1.5 - 4.6	2.7	18/100	14.3	0
	Second	0/4	ND	ND			0
	Third	1/4	1.7	1.7			0
	Fourth	0/4	ND	ND			0
	Fifth	0/4	ND	ND			0
	Sixth	4/4	12.7 - 26.1	20.1			3
Cobalt (Co)	First	0/4	ND	ND	220/NL	2.2	0
	Second	1/4	3.1	3.1			0
	Third	0/4	ND	ND			0
	Fourth	0/4	ND	ND			0
	Fifth	2/4	1.3 - 1.9	1.6			0
	Sixth	3/4	4.0 - 4.7	4.33			0

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Copper (Cu)	First	0/4	ND	ND	150/1,300	4.4	0
	Second	1/1	2.1	2.1			0
	Third	0/4	ND	ND			0
	Fourth	2/4	11.4 - 12.3	11.9			0
	Fifth	1/4	29.3	29.3			0
	Sixth	4/4	3.4 - 16.9	10.2			0
Iron (Fe)	First	4/4	2,480 - 4,420	3,390	NL/NL	NL	NA
	Second	4/4	879 - 8,570	3,840			NA
	Third	2/4	1,740 - 3,490	2,620			NA
	Fourth	3/4	211 - 3,950	1,780			NA
	Fifth	4/4	542 - 13,700	5,830			NA
	Sixth	4/4	795 - 4,420	2,429			NA
Lead (Pb)	First	3/4	2.1 - 4.0	2.9	15/15	4.4	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	0/4	ND	ND			0
	Fifth	0/4	ND	ND			0
	Sixth	0/4	ND	ND			0
	Seventh	0/6	ND	ND			0
Magnesium (Mg)	First	4/4	111,000 - 140,000	123,000	NL/NL	NL	NA
	Second	4/4	89,500 - 120,000	101,000			NA
	Third	4/4	108,000 - 171,000	126,000			NA
	Fourth	4/4	59,900 - 92,800	78,400			NA
	Fifth	4/4	57,100 - 257,000	120,000			NA
	Sixth	4/4	91,000 - 160,000	125,075			NA
Manganese (Mn)	First	4/4	165 - 1,330	735	73/NL	5,430	0
	Second	4/4	327 - 3,290	1,660			0
	Third	2/4	215 - 1,750	983			0
	Fourth	4/4	43.5 - 134	94.6			0
	Fifth	4/4	280 - 2,220	1,020			0
	Sixth	4/4	223 - 2,820	1,046			0
Nickel (Ni)	First	4/4	2.0 - 23.9	11.9	73/100	13.3	0
	Second	3/4	1.5 - 24	9.9			0
	Third	2/4	1.1 - 2.0	1.6			0
	Fourth	2/4	11.1 - 15.7	13.4			0
	Fifth	1/4	19.3	19.3			0
	Sixth	4/4	6.5 - 23.9	11.6			0
Potassium (K)	First	4/4	60,300 - 105,000	76,100	NL/NL	NL	NA
	Second	4/4	35,600 - 45,200	41,600			NA
	Third	4/4	39,400 - 56,800	46,800			NA
	Fourth	4/4	23,300 - 42,500	34,900			NA
	Fifth	4/4	28,400 - 86,800	48,000			NA
	Sixth	4/4	38,300 - 64,700	50,500			NA
Selenium (Se)	First	0/4	ND	ND	18/50	ND	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	4/4	3.4 - 8.5	5.0			0
	Fifth	0/4	ND	ND			0
	Sixth	1/4	0.93	0.93			0

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Sodium (Na)	First	4/4	375,000 - 895,000	541,000	NL/NL	NL	NA
	Second	4/4	389,000 - 509,000	453,000			NA
	Third	4/4	470,000 - 945,000	644,000			NA
	Fourth	4/4	1,980 - 361,000	170,000			NA
	Fifth	4/4	192,000 - 1,390,000	553,000			NA
	Sixth	4/4	296,000 - 674,000	465,750			NA
Tin (Sn)	First	4/4	104 - 221	177	2,200/NL	NA	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	0/4	ND	ND			0
	Fifth	0/4	ND	ND			0
	Sixth	0/4	ND	ND			0
Thallium (Tl)	First	0/4	ND	ND	0.26/2	2.0	0
	Second	0/4	ND	ND			0
	Third	0/4	ND	ND			0
	Fourth	2/4	2.7 - 5.2	4.0			2
	Fifth	0/4	ND	ND			0
	Sixth	0/4	ND	ND			0
	Seventh	2/6	ND	ND			0
Vanadium (V)	First	0/4	ND	ND	26/NL	14	0
	Second	4/4	1.0 - 1.8	1.2			0
	Third	0/4	ND	ND			0
	Fourth	2/4	5.7 - 6.2	6.0			0
	Fifth	0/4	ND	ND			0
	Sixth	4/4	3.1 - 5.0	3.95			0
Zinc (Zn)	First	4/4	23.3 - 41.4	33.8	1,100/NL	24.4	0
	Second	2/4	4.5 - 8.1	6.3			0
	Third	1/4	29.7	29.7			0
	Fourth	2/4	6.4 - 8.4	7.4			0
	Fifth	1/4	14.6	14.6			0
	Sixth	4/4	9.1 - 23.4	16.1			0

Notes:

NA = Not Applicable/Not Available

ND = Not Detected/Not Determined

NL = Not Listed

µg/L = Micrograms per liter

See Table 5.6 for inorganic screening concentrations and their sources.

Table 10.8.8
AOC 687 and SWMU 16
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Round	2 nd Round	3 rd Round	4 th Round	5 th Round	6 th Round	7 th Round	Tap- water RBC*	MCL/SMCL*	Shallow Backgrou nd
Volatile Organic Compounds											
Acetone	687GW003	8	NT	NT	ND	ND	ND	NL	370	NA	NA
Methylene chloride	687GW002	15	NT	NT	ND	ND	ND	NL	4.1	NA	NA
	687GW003	2	NT	NT	ND	ND	ND	NL			
Semivolatile Organic Compounds											
bis(2-Ethylhexyl)phthalate (BEHP)	687GW001	ND	NT	NT	NT	NT	ND	NL	4.8	NA	NA
	687GW002	ND	NT	NT	NT	NT	ND	NL			
	687GW003	ND	NT	NT	NT	NT	ND	NL			
	687GW004	ND	NT	NT	NT	NT	ND	NL			
Inorganics											
Aluminum (Al)	687GW002	ND	ND	ND	ND	1000	ND	NL	3700	NL	1440
	687GW003	ND	ND	ND	ND	300	ND	NL			
	687GW004	ND	ND	ND	209	311	ND	NL			
Antimony (SB)	687GW001	NL	NL	NL	NL	NL	NL	ND			
	687GW002	NL	NL	NL	NL	NL	NL	ND			
	687GW003	NL	NL	NL	NL	NL	NL	ND			
	687GW004	NL	NL	NL	NL	NL	NL	ND			
	GDIGW008	NL	NL	NL	NL	NL	NL	ND			
Arsenic (As)	GDIDW008D	NL	NL	NL	NL	NL	NL	ND			
	687GW001	38.6	ND	ND	ND	ND	3.3	ND	0.045	50	23
	687GW002	33.2	73.7	ND	39.3	131	58.3	26.70			
	687GW003	ND	ND	5.6	ND	4.1	4.3	ND			
	687GW004	6.3	ND	ND	ND	8.2	3.3	4.20			
	GDIGW008	NL	NL	NL	NL	NL	NL	3.40			

Table 10.8.8
AOC 687 and SWMU 16
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Round	2 nd Round	3 rd Round	4 th Round	5 th Round	6 th Round	7 th Round	Tap-water RBC*	MCL/SMCL*	Shallow Background
Barium (Ba)	GDIGW008D	NL	NL	NL	NL	NL	NL	ND			
	687GW001	ND	19.3	ND	20.8	ND	42.7	ND	260	2000	110
	687GW002	ND	16.6	ND	13.8	25.1	25	ND			
	687GW003	ND	22.2	ND	13	17.7	22.3	ND			
Beryllium (Be)	687GW004	ND	20.7	ND	16.4	20.6	49.3	ND			
	687GW001	ND	ND	ND	0.4	ND	ND	ND	7.3	4	1.1
	687GW002	ND	ND	ND	0.38	ND	ND	ND			
	687GW003	ND	ND	ND	0.33	ND	0.3	ND			
Chromium (Cr) (total)	687GW004	ND	ND	ND	0.39	ND	ND	ND			
	687GW001	ND	ND	ND	ND	ND	20.9	ND	18	100	14.3
	687GW002	2.1	ND	ND	ND	ND	12.7	ND			
	687GW003	4.6	ND	1.7	ND	ND	20.7	ND			
Cobalt (Co)	687GW004	1.5	ND	ND	ND	ND	26.1	ND			
	687GW001	ND	3.1	ND	ND	1.9	4.3	ND	220	NL	2.2
	687GW003	ND	ND	ND	ND	ND	4.7	ND			
	687GW004	ND	ND	ND	ND	1.3	4	ND			
Copper (Cu)	687GW001	ND	2.1	ND	12.3	ND	16.9	ND	150	1300	4.4
	687GW002	ND	ND	ND	ND	29.3	3.4	ND			
	687GW003	ND	ND	ND	ND	ND	6.5	ND			
	687GW004	ND	ND	ND	11.4	ND	13.8	NL			
Lead (Pb)	687GW001	4	ND	ND	ND	ND	ND	ND	15	15	4.4
	687GW002	2.6	ND	ND	ND	ND	ND	ND			
	687GW003	NL	NL	NL	NL	NL	NL	ND			

Table 10.8.8
AOC 687 and SWMU 16
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Round	2 nd Round	3 rd Round	4 th Round	5 th Round	6 th Round	7 th Round	Tap-water RBC*	MCL/SMCL*	Shallow Background
Manganese (Mn)	687GW004	2.1	ND	ND	ND	ND	ND	ND			
	GD1GW008	NL	NL	NL	NL	NL	NL	2.10			
	GD1GW008D	NL	NL	NL	NL	NL	NL	ND			
	687GW001	1330	3290	ND	43.5	1270	735	NL	73	NL	5430
	687GW002	165	327	ND	115	326	223	NL			
	687GW003	404	796	1750	134	280	404	NL			
Nickel (Ni)	687GW004	1040	2240	215	85.8	2220	2820	NL			
	687GW001	19.4	ND	ND	ND	ND	7.2	ND	73	100	13.3
	687GW002	23.9	24	1.1	15.7	19.3	23.9	ND			
	687GW003	2	1.5	2	11.1	ND	6.5	ND			
Selenium (Se)	687GW004	2.4	4.2	ND	ND	ND	8.6	ND			
	687GW001	ND	ND	ND	3.4	ND	0.93	ND	18	50	ND
	687GW002	ND	ND	ND	8.5	ND	ND	ND			
	687GW003	ND	ND	ND	4.1	ND	ND	ND			
Thallium (Tl)	687GW004	ND	ND	ND	3.9	ND	ND	ND			
	687GW001	ND	ND	ND	5.2	ND	ND	ND	0.26	2	6.6
	687GW002	ND	ND	ND	2.7	ND	ND	ND			
	687GW003	NL	NL	NL	NL	NL	NL	ND			
	687GW004	NL	NL	NL	NL	NL	NL	ND			
	GD1GW008	NL	NL	NL	NL	NL	NL	ND			
Tin (Sn)	GD1GW008D	NL	NL	NL	NL	NL	NL	ND			
	687GW001	104	ND	ND	ND	ND	ND	ND	2200	NL	NA
	687GW002	221	ND	ND	ND	ND	ND	ND			

Table 10.8.8
AOC 687 and SWMU 16
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Round	2 nd Round	3 rd Round	4 th Round	5 th Round	6 th Round	7 th Round	Tap-water RBC	MCL/SMCL *	Shallow Background
Vanadium (V)	687GW003	172	ND	ND	ND	ND	ND	ND	26	NL	14
	687GW004	210	ND	ND	ND	ND	ND	ND			
	687GW001	ND	1	ND	ND	ND	3.1	ND			
	687GW002	ND	1	ND	ND	ND	4.3	ND			
	687GW003	ND	1.1	ND	6.2	ND	5	ND			
Zinc (Zn)	687GW004	ND	1.8	ND	5.7	ND	3.4	ND	1100	NL	24.4
	687GW001	23.3	4.5	29.7	ND	ND	23.4	ND			
	687GW002	41.4	8.1	ND	6.4	14.6	14.8	ND			
	687GW003	34.8	ND	ND	8.4	ND	9.1	ND			
	687GW004	35.7	ND	ND	ND	ND	16.9	ND			

Notes:

a = Background value for non clay samples

* = Tap-water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996e).

1 = Calculated from methods described in USEPA Interim *Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995c).

Bold concentrations exceed both the RBC and the zone background.

All background values for Zone I are based on twice the means of the grid sample concentrations. Background values for the groundwater are based on two sampling rounds in two wells at each depth.

ND = Not Detected

NL = Not Listed

RBC = Risk-based concentration

mg/k = Micrograms per kilograms

µg/L = milligrams per liter

Table 10.8.8
AOC 687 and SWMU 16
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Round	2 nd Round	3 rd Round	4 th Round	5 th Round	6 th Round	7 th Round	Tap-water RBC	MCL/SMCL *	Shallow Background
Volatile Organic Compounds											
Acetone	687GW003	8	NT	NT	ND	ND	ND	NL	370	NA	NA
Methylene chloride	687GW002	15	NT	NT	ND	ND	ND	NL	4.1	NA	NA
	687GW003	2	NT	NT	ND	ND	ND	NL			
Semivolatile Organic Compounds											
bis(2-Ethylhexyl)phthalate (BEHP)	687GW001	ND	NT	NT	NT	NT	ND	NL	4.8	NA	NA
	687GW002	ND	NT	NT	NT	NT	ND	NL			
	687GW003	ND	NT	NT	NT	NT	ND	NL			
	687GW004	ND	NT	NT	NT	NT	ND	NL			
Inorganics											
Aluminum (Al)	687GW002	ND	ND	ND	ND	1000	ND	NL	3700	NL	1440
	687GW003	ND	ND	ND	ND	300	ND	NL			
	687GW004	ND	ND	ND	209	311	ND	NL			
Antimony (SB)	687GW001	NL	NL	NL	NL	NL	NL	ND			
	687GW002	NL	NL	NL	NL	NL	NL	ND			
	687GW003	NL	NL	NL	NL	NL	NL	ND			
	687GW004	NL	NL	NL	NL	NL	NL	ND			
Arsenic (As)	GDIGW003	NL	NL	NL	NL	NL	NL	ND			
	GDIDW008D	NL	NL	NL	NL	NL	NL	ND			
	687GW001	38.6	ND	ND	ND	ND	3.3	ND	0.045	50	23
	687GW002	33.2	73.7	ND	39.3	131	58.3	26.70			
	687GW003	ND	ND	5.6	ND	4.1	4.3	ND			
	687GW004	6.3	ND	ND	ND	8.2	3.3	4.20			
	GDIGW008	NL	NL	NL	NL	NL	NL	3.40			

Table 10.8.8
AOC 687 and SWMU 16
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Round	2 nd Round	3 rd Round	4 th Round	5 th Round	6 th Round	7 th Round	Tap-water RBC	MCL/SMCL *	Shallow Background
Barium (Ba)	GDIGW008D	NL	NL	NL	NL	NL	NL	ND			
	687GW001	ND	19.3	ND	20.8	ND	42.7	ND	260	2000	110
	687GW002	ND	16.6	ND	13.8	25.1	25	ND			
	687GW003	ND	22.2	ND	13	17.7	22.3	ND			
Beryllium (Be)	687GW004	ND	20.7	ND	16.4	20.6	49.3	ND			
	687GW001	ND	ND	ND	0.4	ND	ND	ND	7.3	4	1.1
	687GW002	ND	ND	ND	0.38	ND	ND	ND			
	687GW003	ND	ND	ND	0.33	ND	0.3	ND			
Chromium (Cr) (total)	687GW004	ND	ND	ND	0.39	ND	ND	ND			
	687GW001	ND	ND	ND	ND	ND	20.9	ND	18	100	14.3
	687GW002	2.1	ND	ND	ND	ND	12.7	ND			
	687GW003	4.6	ND	1.7	ND	ND	20.7	ND			
Cobalt (Co)	687GW004	1.5	ND	ND	ND	ND	26.1	ND			
	687GW001	ND	3.1	ND	ND	1.9	4.3	ND	220	NL	2.2
	687GW003	ND	ND	ND	ND	ND	4.7	ND			
	687GW004	ND	ND	ND	ND	1.3	4	ND			
Copper (Cu)	687GW001	ND	2.1	ND	12.3	ND	16.9	ND	150	1300	4.4
	687GW002	ND	ND	ND	ND	29.3	3.4	ND			
	687GW003	ND	ND	ND	ND	ND	6.5	ND			
	687GW004	ND	ND	ND	11.4	ND	13.8	NL			
Lead (Pb)	687GW001	4	ND	ND	ND	ND	ND	ND	15	15	4.4
	687GW002	2.6	ND	ND	ND	ND	ND	ND			
	687GW003	NL	NL	NL	NL	NL	NL	ND			

Table 10.8.8
AOC 687 and SWMU 16
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Round	2 nd Round	3 rd Round	4 th Round	5 th Round	6 th Round	7 th Round	Tap-water RBC*	MCL/SMCL*	Shallow Background
Manganese (Mn)	687GW004	2.1	ND	ND	ND	ND	ND	ND			
	GDIGW008	NL	NL	NL	NL	NL	NL	2.10			
	GDIGW008D	NL	NL	NL	NL	NL	NL	ND			
	687GW001	1330	3290	ND	43.5	1270	735	NL	73	NL	5430
	687GW002	165	327	ND	115	326	223	NL			
	687GW003	404	796	1750	134	280	404	NL			
Nickel (Ni)	687GW004	1040	2240	215	85.8	2220	2820	NL			
	687GW001	19.4	ND	ND	ND	ND	7.2	ND	73	100	13.3
	687GW002	23.9	24	1.1	15.7	19.3	23.9	ND			
	687GW003	2	1.5	2	11.1	ND	6.5	ND			
Selenium (Se)	687GW004	2.4	4.2	ND	ND	ND	8.6	ND			
	687GW001	ND	ND	ND	3.4	ND	0.93	ND	18	50	ND
	687GW002	ND	ND	ND	8.5	ND	ND	ND			
	687GW003	ND	ND	ND	4.1	ND	ND	ND			
Thallium (Tl)	687GW004	ND	ND	ND	3.9	ND	ND	ND			
	687GW001	ND	ND	ND	5.2	ND	ND	ND	0.26	2	6.6
	687GW002	ND	ND	ND	2.7	ND	ND	ND			
	687GW003	NL	NL	NL	NL	NL	NL	ND			
	687GW004	NL	NL	NL	NL	NL	NL	ND			
	GDIGW008	NL	NL	NL	NL	NL	NL	ND			
Tin (Sn)	GDIGW008D	NL	NL	NL	NL	NL	NL	ND			
	687GW001	104	ND	ND	ND	ND	ND	ND	2200	NL	NA
	687GW002	221	ND	ND	ND	ND	ND	ND			

Table 10.8.8
AOC 687 and SWMU 16
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Round	2 nd Round	3 rd Round	4 th Round	5 th Round	6 th Round	7 th Round	Tap-water RBC*	MCL/SMCL*	Shallow Background
Vanadium (V)	687GW003	172	ND	ND	ND	ND	ND	ND	26	NL	14
	687GW004	210	ND	ND	ND	ND	ND	ND			
	687GW001	ND	1	ND	ND	ND	3.1	ND			
	687GW002	ND	1	ND	ND	ND	4.3	ND			
	687GW003	ND	1.1	ND	6.2	ND	5	ND			
Zinc (Zn)	687GW004	ND	1.8	ND	5.7	ND	3.4	ND	1100	NL	24.4
	687GW001	23.3	4.5	29.7	ND	ND	23.4	ND			
	687GW002	41.4	8.1	ND	6.4	14.6	14.8	ND			
	687GW003	34.8	ND	ND	8.4	ND	9.1	ND			
	687GW004	35.7	ND	ND	ND	ND	16.9	ND			

Notes:

a = Background value for non clay samples

* = Tap-water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996e).

1 = Calculated from methods described in *USEPA Interim Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2 (USEPA, 1995c).

Bold concentrations exceed both the RBC and the zone background.

All background values for Zone 1 are based on twice the means of the grid sample concentrations. Background values for the groundwater are based on two sampling rounds in two wells at each depth.

ND = Not Detected

NL = Not Listed

RBC = Risk-based concentration

mg/k = Micrograms per kilograms

µg/L = milligrams per liter

Inorganics in Groundwater

Twenty metals were detected in shallow groundwater at the combined sites. Arsenic exceeded its tap-water RBC and shallow background concentration at well 687002 during the first (33.2 µg/L), second (73.7 µg/L), fourth (39.3 µg/L), fifth (131 µg/L), and sixth (58.3 µg/L) sampling rounds. Arsenic also exceeded its tap-water RBC and shallow background standard at 687001 (38.6 µg/L) during the first sampling round. Chromium exceeded its tap-water RBC and shallow background concentration in well 687001 (20.9 µg/L), 687003 (20.7 µg/L), and 687004 (26.1 µg/L) during the sixth sampling round. Thallium exceeded its tap-water RBC, MCL, and shallow background concentration at wells 687001 (5.2 µg/L) and 687002 (2.7 µg/L) during the fourth sampling round. No other metals exceeded their tap-water RBC, MCL, or shallow background concentration at the combined sites.

Sixteen metals were detected in shallow groundwater at GDI008. Antimony (5.6 µg/L) exceeded its tap-water RBC during the third sampling round. Chromium (22.7 µg/L) exceeded its tap-water RBC and shallow background during the sixth sampling round. All other shallow groundwater metal concentrations were far below their tap-water RBCs, MCLs, and shallow groundwater background concentrations.

Thirteen metals plus cyanide were detected in deep groundwater at GDI08D. During the second sampling round, thallium (5.5 µg/L) exceeded its tap-water RBC, MCL, and deep groundwater background concentration. During the third sampling round, antimony (5.4 µg/L) exceeded its tap-water RBC. All other deep groundwater metal/cyanide concentrations were far below their tap-water RBCs, MCLs, and deep groundwater background concentrations.

An additional groundwater sampling event was conducted on May 25, 1999. Groundwater samples were collected and analyzed for arsenic, lead, antimony, and thallium. Arsenic exceeded its tap-water in wells 687004 (4.20 µg/L) and GDI008 (3.40 µg/L) and exceeded the tap-water RBC and Shallow Groundwater Background in well 687002 with a concentration of 26.70 µg/L. All other analytes were below laboratory detection limits.

10.8.5 Sediment Sampling and Analysis

Sediment was sampled at the combined sites from the locations shown previously on in Figure 10.8.1. The final RFI work plan proposed two sediment samples. These two samples, 687M0001 and 687M0002, were collected from a drainage ditch immediately east of the site to

Inorganics in Groundwater

Twenty metals were detected in shallow groundwater at the combined sites. Arsenic exceeded its tap-water RBC and shallow background concentration at well 687002 during the first (33.2 µg/L), second (73.7 µg/L), fourth (39.3 µg/L), fifth (131 µg/L), and sixth (58.3 µg/L) sampling rounds. Arsenic also exceeded its tap-water RBC and shallow background standard at 687001 (38.6 µg/L) during the first sampling round. Chromium exceeded its tap-water RBC and shallow background concentration in well 687001 (20.9 µg/L), 687003 (20.7 µg/L), and 687004 (26.1 µg/L) during the sixth sampling round. Thallium exceeded its tap-water RBC, MCL, and shallow background concentration at wells 687001 (5.2 µg/L) and 687002 (2.7 µg/L) during the fourth sampling round. No other metals exceeded their tap-water RBC, MCL, or shallow background concentration at the combined sites.

Sixteen metals were detected in shallow groundwater at GDI008. Antimony (5.6 µg/L) exceeded its tap-water RBC during the third sampling round. Chromium (22.7 µg/L) exceeded its tap-water RBC and shallow background during the sixth sampling round. All other shallow groundwater metal concentrations were far below their tap-water RBCs, MCLs, and shallow groundwater background concentrations.

Thirteen metals plus cyanide were detected in deep groundwater at GDI08D. During the second sampling round, thallium (5.5 µg/L) exceeded its tap-water RBC, MCL, and deep groundwater background concentration. During the third sampling round, antimony (5.4 µg/L) exceeded its tap-water RBC. All other deep groundwater metal/cyanide concentrations were far below their tap-water RBCs, MCLs, and deep groundwater background concentrations.

An additional groundwater sampling event was conducted on May 25, 1999. Groundwater samples were collected and analyzed for arsenic, lead, antimony, and thallium. Arsenic exceeded its tap-water in wells 687004 (4.20 µg/L) and GDI008 (3.40 µg/L) and exceeded the tap-water RBC and Shallow Groundwater Background in well 687002 with a concentration of 26.70 µg/L. All other analytes were below laboratory detection limits.

10.8.5 Sediment Sampling and Analysis

Sediment was sampled at the combined sites from the locations shown previously on in Figure 10.8.1. The final RFI work plan proposed two sediment samples. These two samples, 687M0001 and 687M0002, were collected from a drainage ditch immediately east of the site to

Table 10.9.18
 Summary of Risk and Hazard
 AOC 688
 Charleston Naval Complex
 Charleston, South Carolina

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)
Surface Soil and Sediment	Incidental Ingestion	ERR	ERR	ND	ERR	ND
	Dermal Contact	ERR	ERR	ND	ERR	ND
Sum of All Pathways		ERR	ERR	ND	ERR	ND

Notes:

ND = indicates not determined due to the lack of available risk information.

ILCR = indicates incremental excess lifetime cancer risk.

HI = indicates hazard index

LWA = Lifetime-weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A

Table 10.9.18
Summary of Risk and Hazard
AOC 688
Charleston Naval Complex
Charleston, South Carolina

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)
Surface Soil and Sediment	Incidental Ingestion	6E-03	5E-02	NA	2E-03	ND
	Dermal Contact	1E-03	4E-03	ND	8E-04	ND
Sum of All Pathways		7E-03	6E-02	ND	3E-03	ND

Notes:

ND = indicates not determined due to the lack of available risk information.

ILCR = indicates incremental excess lifetime cancer risk.

HI = indicates hazard index

LWA = Lifetime-weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A

Table 10.11.7
SWMU 12
Inorganic Analytical Results for Groundwater (µg/L)

Parameter	Sample Round	Detection Frequency	Detection Range	Mean	Tap-water RBC/MCL	Shallow Background	Number of Samples Exceeding Lower of RBC or MCL and Background
Aluminum (Al)	First	0/3	ND	ND	3700/NL	1440	0
	Second	1/3	31.9	31.9			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
Arsenic (As)	First	1/3	177	177	0.045/50	23	1
	Second	1/3	220	220			1
	Third	1/3	188	188			1
	Fourth	1/3	253	253			1
	Fifth	1/5	128	128			1
Barium (Ba)	First	3/3	70.0 - 139	106	260/2000	110	0
	Second	3/3	40.8 - 108	64.5			0
	Third	0/3	ND	ND			0
	Fourth	3/3	53.1 - 119	79.9			0
Beryllium (Be)	First	0/3	ND	ND	7.3/4	1.1	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	3/3	0.51 - 0.8	0.62			0
Cadmium (Cd)	First	2/3	0.3 - 3.1	1.7	1.8/5	NA	1
	Second	1/3	1.1	1.1			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
Calcium (Ca)	First	3/3	175,000 - 655,000	340,000	NL/NL	NL	NA
	Second	3/3	173,000 - 748,000	368,000			NA
	Third	3/3	170,000 - 782,000	378,000			NA
	Fourth	3/3	167,000 - 683,000	346,000			NA
Chromium (Cr)	First	3/3	1.2 - 1.75	1.55	18/100	14.3	0
	Second	0/3	ND	ND			0
	Third	1/3	1.4	1.4			0
	Fourth	0/3	ND	ND			0
Cobalt (Co)	First	2/3	0.75 - 7.2	3.98	220/NL	2.2	0
	Second	1/3	4.8	4.8			0
	Third	1/3	5.0	5.0			0
	Fourth	1/3	3.7	3.7			0
Iron (Fe)	First	3/3	68.5 - 93,700	31,900	NL/NL	NL	NA
	Second	3/3	119 - 93,500	31,600			NA
	Third	3/3	24.6 - 104,000	34,800			NA

Table 10.11.7
SWMU 12
Inorganic Analytical Results for Groundwater (µg/L)

Parameter	Sample Round	Detection Frequency	Detection Range	Mean	Tap-water RBC/MCL	Shallow Background	Number of Samples Exceeding Lower of RBC or MCL and Background
Lead (Pb)	Fourth	3/3	811 - 48,000	16,700			NA
	First	3/3	1.9 - 4.9	3.2	15/15	4.4	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
Magnesium (Mg)	Fifth	0/5	ND	ND			0
	First	3/3	318,000 - 651,000	470,000	NL/NL	NL	NA
	Second	3/3	303,000 - 490,000	398,000			NA
	Third	3/3	346,000 - 507,000	440,000			NA
	Fourth	3/3	202,000 - 553,000	383,000			NA
Manganese (Mn)	First	3/3	101 - 4,870	1700	73/261	5430	0
	Second	3/3	66.8 - 4,920	1,701			0
	Third	3/3	56.5 - 2,860	998			0
	Fourth	3/3	62.6 - 2,770	1,018			0
Nickel (Ni)	First	2/3	1.5 - 124	62.8	73/100	13.3	1
	Second	1/3	88.1	88.1			1
	Third	1/3	167	167			1
	Fourth	1/3	48.7	48.7			0
Potassium (K)	First	3/3	151,000 - 285,000	223,000	NL/NL	NL	NA
	Second	3/3	86,800 - 207,000	158,300			NA
	Third	3/3	91,700 - 163,000	137,600			NA
	Fourth	2/3	182,000 - 228,000	205,000			NA
Selenium (Se)	First	1/3	6.1	6.1	18/50	ND	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
Sodium (Na)	First	3/3	1,550,000 - 4,610,000	3,237,000	NL/NL	NL	NA
	Second	3/3	1,900,000 - 4,160,000	3,317,000			NA
	Third	3/3	2,060,000 - 4,830,000	3,860,000			NA
	Fourth	3/3	1,270,000 - 3,800,000	2,710,000			NA
Thallium (Tl)	First	0/3	ND	ND	0.26/2	2.0	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	1/3	4.3	4.3			1
	Fifth	2/5	2.4 - 2.5	2.45			2
	First	3/3	236 - 374	299			0

Table 10.11.7
SWMU 12
Inorganic Analytical Results for Groundwater (µg/L)

Parameter	Sample Round	Detection Frequency	Detection Range	Mean	Tap-water RBC/MCL	Shallow Background	Number of Samples Exceeding Lower of RBC or MCL and Background
Tin (Sn)	Second	0/3	ND	ND	2,200/NL	NA	0
	Third	0/3	ND	ND			0
	Fourth	1/3	2.9	2.9			0
Vanadium (V)	First	3/3	1.0 - 10.0	5.07	26/NL	14	0
	Second	3/3	1.8 - 3.5	2.8			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
Zinc (Zn)	First	3/3	18.0 - 47.2	35.8	1100/NL	24.4	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	1/3	5.6	5.6			0

Notes:

NL = Not Listed

NA = Not Applicable/Not Available/Not Analyzed

ND = Not Detected/Not Determined

µg/L = micrograms per liter

See Table 5.6 for inorganic screening concentrations and their sources.

Table 10.11.8
SWMU 12
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter	5 th Event	Tap-water RBC*	MCL/SMCL*	Shallow Background
Volatile Organic Compounds									
Acetone	012GW002	8	NT	NT	ND	NL	370	NA	NA
Chlorobenzene	012GW001	1	NT	NT	ND	NL	3.5	NA	NA
Semivolatile Organic Compounds									
Benzoic acid	012GW002	ND	NT	NT	1	NL	15000	NA	NA
Di-n-butylphthalate	012GW003	4	NT	NT	ND	NL	370	NA	NA
bis(2-Ethylhexyl)phthalate (BEHP)	012GW003	ND	NT	NT	20	NL	4.8	NA	NA
Pesticides and PCBs									
Endrin aldehyde	012GW003	0.03	NT	NT	ND	NL	1.1	2	NA
Dioxin Compounds									
2,3,7,8-TCDD equivalents (TEQs)	012GW001	4.50	NT	NT	ND	NL	0.45	30	NA
	012GW002	ND	NT	NT	0.004	NL			
123678-HxCDD	012GW001	1.938	NT	NT	ND	NL	4.5	NA	NA
1234678-HpCDD	012GW001	14.857	NT	NT	ND	NL	45	NA	NA
	012GW003	2.031	NT	NT	ND	NL			
OCDD	012GW001	105.868	NT	NT	ND	NL	450	NA	NA
	012GW002	ND	NT	NT	4.38	NL			
	012GW003	4.928	NT	NT	ND	NL			
12378-PeCDF	012GW001	2.671	NT	NT	ND	NL	8.9	NA	NA
123478-HxCDF	012GW001	7.691	NT	NT	ND	NL	4.5	NA	NA
123678-HxCDF	012GW001	7.076	NT	NT	ND	NL	4.5	NA	NA
123789-HxCDF	012GW001	6.766	NT	NT	ND	NL	4.5	NA	NA
	012GW003	2.95	NT	NT	ND	NL			
234678-HxCDF	012GW001	2.838	NT	NT	ND	NL	4.5	NA	NA
1234678-HpCDF	012GW001	111.889	NT	NT	ND	NL	45	NA	NA

Table 10.11.8
SWMU 12
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter	5 th Event	Tap-water RBC*	MCL/SMCL*	Shallow Background
OCDF	012GW003	4.379	NT	NT	ND	NL			
	012GW001	359.642	NT	NT	ND	NL	450	NA	NA
	012GW003	1.985	NT	NT	ND	NL			
Inorganics (mg/L)									
Aluminum (Al)	012GW001	ND	31.9	ND	ND	NL	3700	NL	1440
Arsenic (As)	012GW002	177	220	188	253	128	0.045	50	23
Barium (Ba)	012GW001	70	40.8	ND	53.1	NL	260	2000	110
	012GW002	139	108	ND	119	NL			
	012GW003	108.85	44.7	ND	67.6	NL			
Beryllium (Be)	012GW001	ND	ND	ND	0.51	NL	7.3	4	1.1
	012GW002	ND	ND	ND	0.8	NL			
	012GW003	ND	ND	ND	0.55	NL			
Cadmium (Cd)	012GW002	3.1	1.1	ND	ND	NL	1.8	5	NA
	012GW003	0.3	ND	ND	ND	NL			
Chromium (Cr) (total)	012GW001	1.7	ND	ND	ND	NL	18	100	14.3
	012GW002	1.2	ND	1.4	ND	NL			
Cobalt (Co)	012GW003	1.75	ND	ND	ND	NL			
	012GW002	7.2	4.8	5	3.7		220	NL	2.2
	012GW003	0.75	ND	ND	ND	NL			
Lead (Pb)	012GW001	1.9	ND	ND	ND	ND	15	15	4.4
	012GW002	4.9	ND	ND	ND	ND			
	012GW003	2.9	ND	ND	ND	ND			
Manganese (Mn)	012GW001	129	116	76.5	222	NL	73	NL	5430
	012GW002	4870	4920	2860	2770	NL			
	012GW003	100.75	66.8	56.5	62.6	NL			

Table 10.11.8
SWMU 12
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter	5 th Event	Tap-water RBC*	MCL/SMCL*	Shallow Background
Nickel (Ni)	012GW002	124	88.1	167	48.7	NL	73	100	13.3
	012GW003	1.5	ND	ND	ND	NL			
Selenium (Se)	012GW002	6.1	ND	ND	ND	NL	18	50	ND
Thallium (Tl)	012GW001	ND	ND	ND	ND	2.4	0.26	2	6.6
	012GW002	ND	ND	ND	ND	2.5			
	012GW003	ND	ND	ND	4.3	ND			
Tin (Sn)	012GW001	288	ND	ND	ND	NL	2200	NL	NA
	012GW002	374	ND	ND	ND	NL			
	012GW003	236	ND	ND	2.9	NL			
Vanadium (V)	012GW001	4.2	3.5	ND	ND	NL	26	NL	14
	012GW002	10	3.1	ND	ND	NL			
	012GW003	ND	1.8	ND	ND	NL			
	012GW003	1	ND	ND	ND	NL			
Zinc (Zn)	012GW001	43.4	ND	ND	ND	NL	1100	NL	24.4
	012GW002	47.2	ND	ND	5.6	NL			
	012GW003	18	ND	ND	ND	NL			

Notes:

- * = Tap-water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996e)

Bold concentrations exceed both the RBC and the zone background

All background values for Zone I are based on twice the means of the grid sample concentrations. Background values for the groundwater are based on two sampling rounds in two wells at each depth.

NA = Not applicable/not available

ND = Not detected

NL = Not listed

NT = Not taken

RBC = Risk-based concentration

pg/L = Picograms per liter

mg/kg = Micrograms per kilogram

µg/L = Micrograms per liter

Table 10.11.7
SWMU 12
Inorganic Analytical Results for Groundwater (µg/L)

Parameter	Sample Round	Detection Frequency	Detection Range	Mean	Tap-water RBC/MCL	Shallow Background	Number of Samples Exceeding Lower of RBC or MCL and Background
Aluminum (Al)	First	0/3	ND	ND	3700/NL	1440	0
	Second	1/3	31.9	31.9			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
Arsenic (As)	First	1/3	177	177	0.045/50	23	1
	Second	1/3	220	220			1
	Third	1/3	188	188			1
	Fourth	1/3	253	253			1
	Fifth	1/5	128	128			1
Barium (Ba)	First	3/3	70.0 - 139	106	260/2000	110	0
	Second	3/3	40.8 - 108	64.5			0
	Third	0/3	ND	ND			0
	Fourth	3/3	53.1 - 119	79.9			0
Beryllium (Be)	First	0/3	ND	ND	7.3/4	1.1	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	3/3	0.51 - 0.8	0.62			0
Cadmium (Cd)	First	2/3	0.3 - 3.1	1.7	1.8/5	NA	1
	Second	1/3	1.1	1.1			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
Calcium (Ca)	First	3/3	175,000 - 655,000	340,000	NL/NL	NL	NA
	Second	3/3	173,000 - 748,000	368,000			NA
	Third	3/3	170,000 - 782,000	378,000			NA
	Fourth	3/3	167,000 - 683,000	346,000			NA
Chromium (Cr)	First	3/3	1.2 - 1.75	1.55	18/100	14.3	0
	Second	0/3	ND	ND			0
	Third	1/3	1.4	1.4			0
	Fourth	0/3	ND	ND			0
Cobalt (Co)	First	2/3	0.75 - 7.2	3.98	220/NL	2.2	0

Table 10.11.7
 SWMU 12
 Inorganic Analytical Results for Groundwater (µg/L)

Parameter	Sample Round	Detection Frequency	Detection Range	Mean	Tap-water RBC/MCL	Shallow Background	Number of Samples Exceeding Lower of RBC or MCL and Background
Iron (Fe)	Second	1/3	4.8	4.8	NL/NL	NL	0
	Third	1/3	5.0	5.0			0
	Fourth	1/3	3.7	3.7			0
	First	3/3	68.5 - 93,700	31,900			NA
	Second	3/3	119 - 93,500	31,600			NA
	Third	3/3	24.6 - 104,000	34,800			NA
	Fourth	3/3	811 - 48,000	16,700			NA
Lead (Pb)	First	3/3	1.9 - 4.9	3.2	15/15	4.4	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
	Fifth	0/5	ND	ND			0
Magnesium (Mg)	First	3/3	318,000 - 651,000	470,000	NL/NL	NL	NA
	Second	3/3	303,000 - 490,000	398,000			NA
	Third	3/3	346,000 - 507,000	440,000			NA
	Fourth	3/3	202,000 - 553,000	383,000			NA
Manganese (Mn)	First	3/3	101 - 4,870	1700	73/261	5430	0
	Second	3/3	66.8 - 4,920	1,701			0
	Third	3/3	56.5 - 2,860	998			0
	Fourth	3/3	62.6 - 2,770	1,018			0
Nickel (Ni)	First	2/3	1.5 - 124	62.8	73/100	13.3	1
	Second	1/3	88.1	88.1			1
	Third	1/3	167	167			1
	Fourth	1/3	48.7	48.7			0
Potassium (K)	First	3/3	151,000 - 285,000	223,000	NL/NL	NL	NA
	Second	3/3	86,800 - 207,000	158,300			NA
	Third	3/3	91,700 - 163,000	137,600			NA
	Fourth	2/3	182,000 - 228,000	205,000			NA
Selenium (Se)	First	1/3	6.1	6.1	18/50	ND	0
	Second	0/3	ND	ND			0

Table 10.11.7
SWMU 12
Inorganic Analytical Results for Groundwater (µg/L)

Parameter	Sample Round	Detection Frequency	Detection Range	Mean	Tap-water RBC/MCL	Shallow Background	Number of Samples Exceeding Lower of RBC or MCL and Background
Sodium (Na)	Third	0/3	ND	ND	NL/NL	NL	0
	Fourth	0/3	ND	ND			0
	First	3/3	1,550,000 - 4,610,000	3,237,000			NA
	Second	3/3	1,900,000 - 4,160,000	3,317,000			NA
	Third	3/3	2,060,000 - 4,830,000	3,860,000			NA
Thallium (Tl)	Fourth	3/3	1,270,000 - 3,800,000	2,710,000	0.26/2	2.0	NA
	First	0/3	ND	ND			0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	1/3	4.3	4.3			1
Tin (Sn)	Fifth	2/5	2.4 - 2.5	2.45	2,200/NL	NA	2
	First	3/3	236 - 374	299			0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	1/3	2.9	2.9			0
Vanadium (V)	First	3/3	1.0 - 10.0	5.07	26/NL	14	0
	Second	3/3	1.8 - 3.5	2.8			0
	Third	0/3	ND	ND			0
	Fourth	0/3	ND	ND			0
Zinc (Zn)	First	3/3	18.0 - 47.2	35.8	1100/NL	24.4	0
	Second	0/3	ND	ND			0
	Third	0/3	ND	ND			0
	Fourth	1/3	5.6	5.6			0

Notes:

NL = Not Listed

NA = Not Applicable/Not Available/Not Analyzed

ND = Not Detected/Not Determined

µg/L = micrograms per liter

See Table 5.6 for inorganic screening concentrations and their sources.

Table 10.11.8
SWMU 12
 Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter	5 th Event	Tap-water RBC*	MCL/SMCL*	Shallow Background
Volatile Organic Compounds									
Acetone	012GW002	8	NT	NT	ND	NL	370	NA	NA
Chlorobenzene	012GW001	1	NT	NT	ND	NL	3.5	NA	NA
Semivolatile Organic Compounds									
Benzoic acid	012GW002	ND	NT	NT	1	NL	15000	NA	NA
Di-n-butylphthalate	012GW003	4	NT	NT	ND	NL	370	NA	NA
bis(2-Ethylhexyl)phthalate (BEHP)	012GW003	ND	NT	NT	20	NL	4.8	NA	NA
Pesticides and PCBs									
Endrin aldehyde	012GW003	0.03	NT	NT	ND	NL	1.1	2	NA
Dioxin Compounds									
2,3,7,8-TCDD equivalents (TEQs)	012GW001	4.50	NT	NT	ND	NL	0.45	30	NA
	012GW002	ND	NT	NT	0.004	NL			
123678-HxCDD	012GW001	1.938	NT	NT	ND	NL	4.5	NA	NA
1234678-HpCDD	012GW001	14.857	NT	NT	ND	NL	45	NA	NA
	012GW003	2.031	NT	NT	ND	NL			
OCDD	012GW001	105.868	NT	NT	ND	NL	450	NA	NA
	012GW002	ND	NT	NT	4.38	NL			
	012GW003	4.928	NT	NT	ND	NL			
12378-PeCDF	012GW001	2.671	NT	NT	ND	NL	8.9	NA	NA
123478-HxCDF	012GW001	7.691	NT	NT	ND	NL	4.5	NA	NA

Table 10.11.8
 SWMU 12
 Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter	5 th Event	Tap-water RBC*	MCL/SMCL*	Shallow Background
123678-HxCDF	012GW001	7.076	NT	NT	ND	NL	4.5	NA	NA
123789-I HxCDF	012GW001	6.766	NT	NT	ND	NL	4.5	NA	NA
	012GW003	2.95	NT	NT	ND	NL			
234678-HxCDF	012GW001	2.838	NT	NT	ND	NL	4.5	NA	NA
1234678-I HpCDF	012GW001	111.889	NT	NT	ND	NL	45	NA	NA
	012GW003	4.379	NT	NT	ND	NL			
OCDF	012GW001	359.642	NT	NT	ND	NL	450	NA	NA
	012GW003	1.985	NT	NT	ND	NL			
organics (mg/L)									
Aluminum (Al)	012GW001	ND	31.9	ND	ND	NL	3700	NL	1440
Arsenic (As)	012GW002	177	220	188	253	128	0.045	50	23
Barium (Ba)	012GW001	70	40.8	ND	53.1	NL	260	2000	110
	012GW002	139	108	ND	119	NL			
	012GW003	108.85	44.7	ND	67.6	NL			
Beryllium (Be)	012GW001	ND	ND	ND	0.51	NL	7.3	4	1.1
	012GW002	ND	ND	ND	0.8	NL			
	012GW003	ND	ND	ND	0.55	NL			
Cadmium (Cd)	012GW002	3.1	1.1	ND	ND	NL	1.8	5	NA
	012GW003	0.3	ND	ND	ND	NL			
Chromium (Cr) (total)	012GW001	1.7	ND	ND	ND	NL	18	100	14.3
	012GW002	1.2	ND	1.4	ND	NL			

Table 10.11.8
SWMU 12
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter	5 th Event	Tap-water RBC*	MCL/SMCL*	Shallow Background
Cobalt (Co)	012GW003	1.75	ND	ND	ND	NL			
	012GW002	7.2	4.8	5	3.7		220	NL	2.2
	012GW003	0.75	ND	ND	ND	NL			
Lead (Pb)	012GW001	1.9	ND	ND	ND	ND	15	15	4.4
	012GW002	4.9	ND	ND	ND	ND			
	012GW003	2.9	ND	ND	ND	ND			
Manganese (Mn)	012GW001	129	116	76.5	222	NL	73	NL	5430
	012GW002	4870	4920	2860	2770	NL			
	012GW003	100.75	66.8	56.5	62.6	NL			
Nickel (Ni)	012GW002	124	88.1	167	48.7	NL	73	100	13.3
	012GW003	1.5	ND	ND	ND	NL			
Selenium (Se)	012GW002	6.1	ND	ND	ND	NL	18	50	ND
Thallium (Tl)	012GW001	ND	ND	ND	ND	2.4	0.26	2	6.6
	012GW002	ND	ND	ND	ND	2.5			
	012GW003	ND	ND	ND	4.3	ND			
Tin (Sn)	012GW001	288	ND	ND	ND	NL	2200	NL	NA
	012GW002	374	ND	ND	ND	NL			
	012GW003	236	ND	ND	2.9	NL			
Vanadium (V)	012GW001	4.2	3.5	ND	ND	NL	26	NL	14
	012GW002	10	3.1	ND	ND	NL			

Table 10.11.8
SWMU 12
Analytes Detected in Shallow Groundwater (µg/L)

Parameter	Location	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter	5 th Event	Tap-water RBC*	MCL/SMCL*	Shallow Background
Zinc (Zn)	012GW003	ND	1.8	ND	ND	NL			
	012GW003	1	ND	ND	ND	NL			
	012GW001	43.4	ND	ND	ND	NL	1100	NL	24.4
	012GW002	47.2	ND	ND	5.6	NL			
	012GW003	18	ND	ND	ND	NL			

Notes:

* = Tap-water RBCs (THQ=0.1) from *Risk-Based Concentration Table* (USEPA, October 22, 1997), and MCLs/SMCLs from *Drinking Water Regulations and Health Advisories* (USEPA, 1996e)

Bold concentrations exceed both the RBC and the zone background

All background values for Zone I are based on twice the means of the grid sample concentrations. Background values for the groundwater are based on two sampling rounds in two wells at each depth.

NA = Not applicable/not available
ND = Not detected
NL = Not listed
NT = Not taken
RBC = Risk-based concentration
pg/L = Picograms per liter
mg/kg = Micrograms per kilogram
µg/L = Micrograms per liter

TEQs ranged from $8.9\text{E-}9$ $\mu\text{g/L}$ to $3.41\text{E-}6$ $\mu\text{g/L}$. TEQs calculated for GDI00303 ($1.76\text{E-}6$ $\mu\text{g/L}$) and GDI00304 ($3.41\text{E-}6$ $\mu\text{g/L}$) are above the RBC.

Dioxins were detected in the first-round deep well sample. The TEQ calculated for this sample was $7.27\text{E-}7$ $\mu\text{g/L}$, which is below the MCL.

Inorganics in Groundwater

Twenty metals were detected in SWMU 12 groundwater over the four sampling rounds; however only four – arsenic, cadmium, nickel, and thallium – exceeded their respective screening criteria. Arsenic exceeded its tap-water RBC, MCL, and shallow background concentration in all four sampling events, with concentrations ranging from 177 to 253 $\mu\text{g/L}$. All of these exceedances were in samples from well 012002; the maximum concentration was detected in the fourth-round sample. Arsenic was not detected in any other SWMU 12 well. Cadmium was detected in the first- and second-round samples, but exceeded screening concentrations only in the first-round sample at well 012003. Nickel was detected in all four sampling rounds at well 012002, with concentrations ranging from 48.7 to 167 $\mu\text{g/L}$. The screening criteria for nickel were exceeded in the first three sampling rounds. Thallium exceeded its screening criteria in the fourth-round sample from well 012003 (4.3 $\mu\text{g/L}$). Thallium was not detected in the first three rounds.

In May 1999, a letter from SCDHEC requested additional sampling at SWMU 12. An additional groundwater sampling event was conducted on May 20, 1999. Groundwater samples were collected and analyzed for arsenic, lead, antimony, and thallium. Arsenic exceeded its tap-water, MCL, and shallow groundwater background in 012002 during this event with a concentration of 128 $\mu\text{g/L}$. Thallium exceeded its tap-water RBC and MCL during this event in wells 012001 and 012002 with concentrations ranging from 2.40 $\mu\text{g/L}$ to 2.50 $\mu\text{g/L}$. All other analytes were below laboratory detection limits.

Nineteen metals were detected in shallow groundwater samples from GDI003, e.g., with only two exceedances. Antimony (3.1 $\mu\text{g/L}$) exceeded its tap-water RBC in the third-round sample. Thallium (2.8 $\mu\text{g/L}$) exceeded its tap-water RBC and shallow groundwater background concentration also in the third-round sample. There were no other exceedances.

Seventeen metals were detected in deep groundwater samples from GDI03D. Only one, antimony exceeded its tap-water RBC (6.1 ug/L in the third-round sample). There was no exceedance of MCL or background.

TEQs ranged from $8.9\text{E-}9$ $\mu\text{g/L}$ to $3.41\text{E-}6$ $\mu\text{g/L}$. TEQs calculated for GDI00303 ($1.76\text{E-}6$ $\mu\text{g/L}$) and GDI00304 ($3.41\text{E-}6$ $\mu\text{g/L}$) are above the RBC.

Dioxins were detected in the first-round deep well sample. The TEQ calculated for this sample was $7.27\text{E-}7$ $\mu\text{g/L}$, which is below the MCL.

Inorganics in Groundwater

Twenty metals were detected in SWMU 12 groundwater over the four sampling rounds; however only four – arsenic, cadmium, nickel, and thallium – exceeded their respective screening criteria. Arsenic exceeded its tap-water RBC, MCL, and shallow background concentration in all four sampling events, with concentrations ranging from 177 to 253 $\mu\text{g/L}$. All of these exceedances were in samples from well 012002; the maximum concentration was detected in the fourth-round sample. Arsenic was not detected in any other SWMU 12 well. Cadmium was detected in the first- and second-round samples, but exceeded screening concentrations only in the first-round sample at well 012003. Nickel was detected in all four sampling rounds at well 012002, with concentrations ranging from 48.7 to 167 $\mu\text{g/L}$. The screening criteria for nickel were exceeded in the first three sampling rounds. Thallium exceeded its screening criteria in the fourth-round sample from well 012003 (4.3 $\mu\text{g/L}$). Thallium was not detected in the first three rounds.

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Nineteen metals were detected in shallow groundwater samples from GDI003, e.g., with only two exceedances. Antimony (3.1 $\mu\text{g/L}$) exceeded its tap-water RBC in the third-round sample. Thallium (2.8 $\mu\text{g/L}$) exceeded its tap-water RBC and shallow groundwater background concentration also in the third-round sample. There were no other exceedances.

Seventeen metals were detected in deep groundwater samples from GDI03D. Only one, antimony exceeded its tap-water RBC (6.1 ug/L in the third-round sample). There was no exceedance of MCL or background.

10.12 SWMU 177/RTC

The SWMU 177/RTC was not addressed in the *Final Zone I RFI Work Plan* (E/A&H, February 1995). This site was determined by USEPA Region IV to warrant limited investigation in conjunction with current construction activities. SWMU 177/RTC consisted of two adjacent buildings, both designated as Building RTC-4. The original RTC-4 was a 24 x 60 foot metal structure used to house heavy equipment including backhoes and trackhoes. The designation RTC-4 was given to a newer building constructed next to the former RTC-4. The newer RTC-4 was used to store lawn mowers and other lawn maintenance equipment. This unit was designated as a SWMU due to oil spillage associated with operations at the two buildings. Visual inspections during the RFA identified several areas of stained soil and concrete in and around the two buildings. These buildings were both less than 50 feet from the Cooper River.

This area was included in a lease agreement between the Navy and the National Oceanographic and Atmospheric Administration (NOAA) in the spring of 1995. Since taking over this area, NOAA has removed both buildings and has installed a diesel fuel AST and three generators at the site.

Materials of concern identified include VOCs, petroleum hydrocarbons, and heavy metals. Potential receptors include current or future site workers who may be involved in invasive activities that might bring them in direct contact with subsurface contaminants. The ecology of the Cooper River is also a potential receptor.

The initial samples were collected to facilitate the property transfer and expansion. Subsequent sampling rounds were conducted to confirm the presence of any contamination from onsite activities. Soil and groundwater were sampled in accordance with Section 3 of this report.

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INITIAL ASSESSMENT STUDY
NAVAL BASE CHARLESTON

VOLUME I

Prepared by:

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC. (ESE)
P.O. Box ESE
Gainesville, Florida 32602

Contract No. N62474-81-C-9383

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Prepared for:

NAVY ASSESSMENT AND CONTROL
OF INSTALLATION POLLUTANTS (NACIP) DEPARTMENT
Naval Energy and Environmental Support Activity (NEESA)
Port Hueneme, California 93043

October 1981

SOUTHDIIV is currently funding a study to determine the location of the pits. The IAS team observed several test borings in the area and noted that they were filled with oil. Using a post hole digger, the IAS team made several additional test holes in the area which also filled with oil. The areal extent of the oil contamination is unknown; however, based on the inferred groundwater gradient, the oil is suspected to be slowly migrating toward the Cooper River. Several oil slicks of undetermined origin have been reported in the Cooper River near the oil pit area. These may be the result of oil which has migrated from the sludge pit area. Oil leaching into the Cooper River could create environmental degradation.

2.4 PETROLEUM, OIL, AND LUBRICANTS (POL) TRANSFER POINT

The POL transfer point is located immediately east of Hobson Ave., directly across from aboveground POL storage tank 3900E. At this location, POL is transferred from railroad tank cars to the storage tanks. During transfer operations, several oil spills have occurred, and oil has leached into the subsoils. In 1981, during the construction of a fence, workers digging holes for fenceposts reported that the holes were filling with oil. The amount of POL in the soil of this area and the areal extent of the contamination are unknown. Subsurface POL could migrate to the Cooper River, resulting in environmental degradation.

2.5 FORMER FIREFIGHTING TRAINING PIT

An unlined firefighting training pit, reportedly measuring between 30 and 50 feet in diameter, was located on the southern end of NAVBASE

Charleston from 1966-71 and contained waste oil, gasoline, and alcohol burned during firefighting training exercises. The pit area is not readily discernible from the ground, but its location is apparent when viewed from the air. Aerial photographs taken in 1971 clearly show the location of the pit. In 1971, the pit was cited by the U.S. Coast Guard, for an oil spill following heavy rainfall which caused the oil in the pit to overflow into Shipyard Creek. The pit was closed in 1972 by leveling and covering with bottom ash, and 4 inches of sludge reportedly lay at its bottom. The amount of oil which may have leached into the subsoil and the areal extent of the pit are unknown. Any oil currently remaining in the soil could leach into Shipyard Creek, resulting in environmental degradation.

2.6 PCB STORAGE AREA

Out-of-service transformers containing PCB fluids are currently stored in Bldg. 3902 in the "Old Corral" area. This building has a concrete floor and is curbed, as required by Federal regulations for PCB storage. Prior to 1976, out-of-service transformers were brought to the concrete pad on the south side of the building where, at the discretion of the purchasing contractor, they were either sold "as is" or their oil dumped. As a result of these actions, the soils around the pad received transformer oils which possibly contained PCBs. PCB-contaminated soils could migrate to the Cooper River via stormwater runoff. SOUTHDIIV currently has a study program to determine if these soils are contaminated with PCBs. If PCB contamination is detected, Federal regulations prescribe that the soils be drummed and disposed of.

10/14/81

Table 4.1-1 Summary of Recommended Confirmation Study					
Potentially Contaminated Area	Monitor Wells	Soil Borings	Soil Samples	Field Analytical Techniques	Laboratory Analytical Parameters
Sanitary Landfill	7	—	—	—	Parameters listed in table 4.1-2
Chemical Disposal Area	—	—	—	GPR, magnetometer metal detector, and EM	—
Oil Sludge Pits Option 1	—	150*	50	—	Oil and grease or petroleum hydrocarbons
Option 2	—	10*	—	GPR, EM, and portable GC	—
POL Transfer Point Option 1	—	100*	50	—	Oil and grease or petroleum hydrocarbons
Option 2	—	10*	—	GPR, EM, and portable GC	—
Former Firefighting Training Pit Option 1	—	5†	5	Portable GC	—
Option 2	—	—	—	—	Oil and grease or petroleum hydrocarbons
PCB Area	—	—	25	—	PCBs
Former Pesticide Mixing and Storage Area	—	—	8	—	Parameters listed in table 4.1-3
Caustic Pond	—	25-50†	—	—	—

* Power auger.

† Hand auger.

GPR = Ground-penetrating radar.

EM = Electromagnetism.

Source: ZSE, 1981.

ground water in the area of the oil sludge pits. The exact configuration of the oil lens was not determined at the time of the assessment. A noncontact terrain conductivity meter (Geonics EM-31®) was employed to define the extent of the oil lens, but the extreme heterogeneity of the shallow subsurface and the presence of many buried conductors prevented a definitive interpretation of the data. Several shallow holes (2 to 5 feet deep) were dug at conductivity lows, and oil was found in each (see figure 6.6-5⁶).

6.6.2.3 Chemical Disposal Area

Undisclosed amounts of a variety of chemicals, including the decontaminants DANC and DS2, were reportedly buried in the area of the pistol and skeet ranges (see figure 6.6-5 and appendix H). In 1972 and 1974, construction crews working in the area unearthed drums of chemicals, and minor injuries resulted. Reportedly, in the 1960s, unknown chemicals of several types were buried in the skeet range and the dike behind the pistol range (see figure 6.6-5). In 1977, ten 5-gallon cannisters of DS2 were reportedly buried in the skeet range.

6.6.2.4 Former Firefighting Training Pit

A circular, unlined pit, measuring 30 to 50 feet in diameter and 18 inches deep, was used from 1966 to 1971 to burn waste oil, gasoline, or alcohol for the training of NAVSTA firefighters. This pit was located near the southern end of NAVBASE Charleston, on the Shipyard Creek side (see figure 6.6-5). Most of the flammable material was burned during each training exercise. This pit was not intended for

storage or disposal but strictly for training. Despite the installation of a drain, heavy rains caused the pit to fill with water, displacing the oil and allowing it to flow into Shipyard Creek. Coast Guard citations on these spills led to closure of the pit in 1971, and in 1972, it was leveled and covered with bottom ash. At the time of leveling, there was reportedly 4 inches of oily sludge in the bottom of the pit. No oil or oily residue could be located in the area of the pit during the site assessment. The pit area is not readily discernible from the ground, but its location is apparent from the air and is also clearly shown on aerial photographs taken in 1971.

6.6.2.5 Caustic Pit

The caustic pit, located near the junction of Bainbridge Ave. and Viaduct Rd., was used between the early 1940s and the early 1970s for the disposal of lime sludge generated as a byproduct of acetylene production. Water saturated with lime was allowed to settle in a pond, while excess water was discharged to Shipyard Creek. Part of the pond was filled in during construction of Bainbridge Ave. The pond was abandoned rather than closed, and no lime was removed or covered when the acetylene production ceased. The remainder of the pond (the portion which was not filled by the Bainbridge Ave. construction) still exists, and lime sludge can be seen on the water's edge. Trees, shrubs, and grass grow down to the water's edge, and aquatic plants grow in the pond itself. A litmus paper test of the pond water conducted during the onsite assessment yielded a pH of 7. Shallow (2.5-foot) soil borings in the area indicated the presence of approximately 1 foot of lime sludge

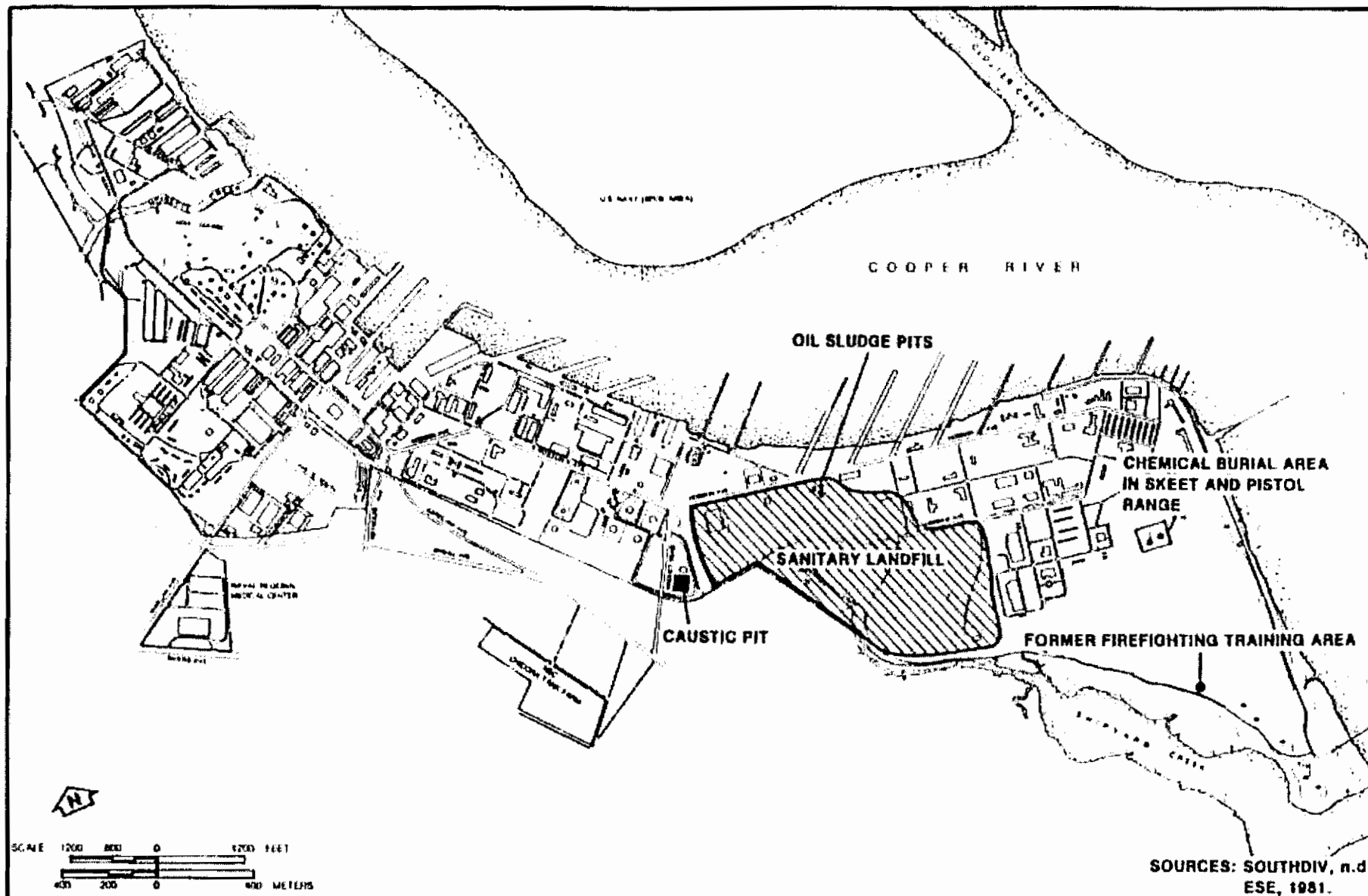


Figure 6.6-5
SOLID WASTE DISPOSAL AREAS



INITIAL ASSESSMENT STUDY
NAVAL BASE CHARLESTON

Geraghty & Miller, Inc.

FINAL SUBMISSION (100%)
CONFIRMATION STUDY

ASSESSMENT OF POTENTIAL OIL AND
HAZARDOUS-WASTE CONTAMINATION OF SOIL
AND GROUND WATER AT THE
CHARLESTON NAVAL SHIPYARD,
CHARLESTON, SOUTH CAROLINA

Prepared for

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
Charleston, South Carolina

October 29, 1982

GERAGHTY & MILLER, INC.
Water-Resources Consultants
13902 North Dale Mabry Highway
Tampa, Florida

EXECUTIVE SUMMARY

Introduction

This Confirmation Study was performed at the Naval Shipyard in Charleston, South Carolina, to fulfill the Phase II requirements of the Navy Assessment and Control of Installation Pollutants Program. This study was a follow-up to the Phase I Initial Assessment Study, which involved an on-site investigation to verify and characterize the presence of soil and ground-water contamination at eight sites. The sites studied included the following areas identified in Figure 2: (1) caustic-pond area, (2) chemical-disposal area, (3) landfill area, (4) pesticide-mixing area, (5) electrical-transformer storage area, (6) oil-sludge pit area, (7) POL-transfer area, and (8) former fire-fighting training pit.

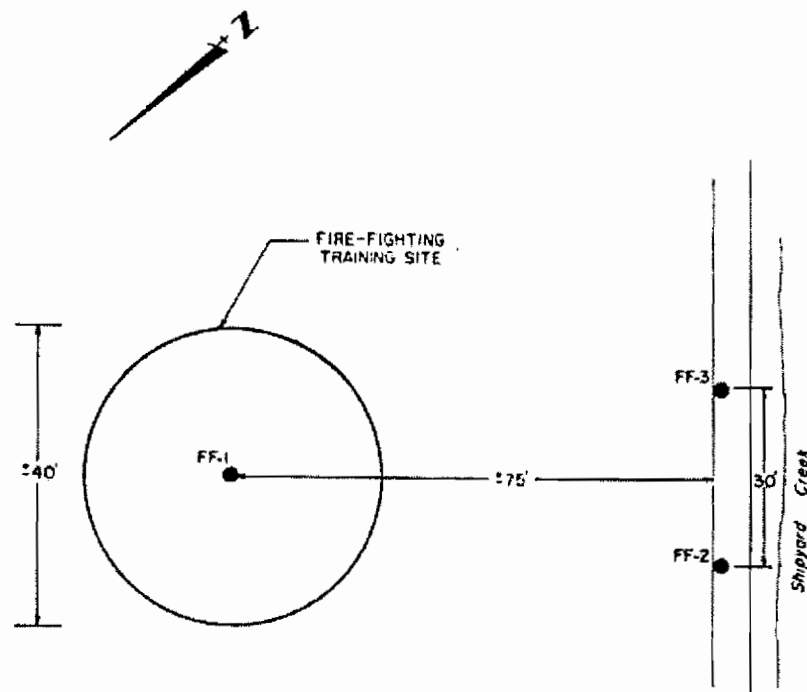
During this investigation, a total of 132 shallow borings were drilled; 29 monitor wells were installed; and 26 soil samples were collected for chemical analyses. Water samples were also collected from each of the monitor wells and analyzed for selected chemical and physical constituents (see Appendices C through H for analyses results).

Hydrogeologic Setting

The Charleston Naval Shipyard is located on a peninsula of land and is surrounded on three sides by brackish surface water of the Cooper River. The topography of the shipyard,

Fire-Fighting Training Pit

The fire-fighting training pit is located at the southern end of the shipyard (see Figure 3) and is no longer in use. It reportedly ranged between 30 to 50 ft in diameter and was used between 1966 and 1971 for training purposes. Oil, gasoline, and alcohol were poured into this pit, ignited, and subsequently extinguished during fire-fighting training exercises. The approximate location of the pit was determined by NAVFAC personnel and three soil borings were drilled. These borings were drilled at the fire-fighting pit, one in the center of the pit, and the other two along the road bordering Shipyard Creek (Figure 17). No oil nor any traces of oil were found in any of the borings.



NOT TO SCALE

EXPLANATION

FF-2 ● SHALLOW BORING LOCATION AND NUMBER

Figure 17. Locations of the Oil-Test Borings Installed at the Former Fire-Fighting Pit.

would be pumped so that the oil could be separated from the water. The oil could then be sold as waste oil or burned in an incinerator, and the water can be reintroduced into the shallow ground-water system to speed up the oil-recovery process. Presented in Figure 18 is a schematic diagram showing the layout of a possible oil-collection system using ditches. The cost of installing this system is estimated to be \$45,000 to \$60,000.

Given the low potential for this oil to move laterally through the ground-water system, it may be more cost effective to install a bypass pipe in the existing ditch with a simple collection system at the downstream end. The ditch would still serve its purpose of conveying surface-water runoff away from the site while preventing the oil from entering the ditch. The collection system would periodically be pumped to remove any oil that collects in it.

POL-Transfer Area

No oil plumes were found in the POL-transfer area; therefore, no remedial actions are required.

Former Fire-Fighting Training Pit

As in the case of the POL-transfer area, no oil plumes were detected in the shallow deposits; therefore, no remedial actions are required.

DISCUSSIONS/DECISIONS (Continued)

EXCERPTED FROM:

Naval Base Charleston Environmental Cleanup Project Team Meeting Minutes

Date: 24 to 25 Aug 99

Place: NH-C/Project Team Room

Time: 0800 - 1700

Attendees: Tony Hunt (SDIV); Paul Bergstrand, Mihir Mehta, Charles Watson, Eric Cathcart, Susan Byrd, Susan Peterson (DHEC); Dann Spariosu (USEPA); Todd Haverkost, Charlie Vernoy, Larry Bowers (EnSafe); Joe Land (CLD)

Invited Guests: Kevin Tunstall (DET); Ted Blahnik, Don Schroeder, Greg Temple (EnSafe)

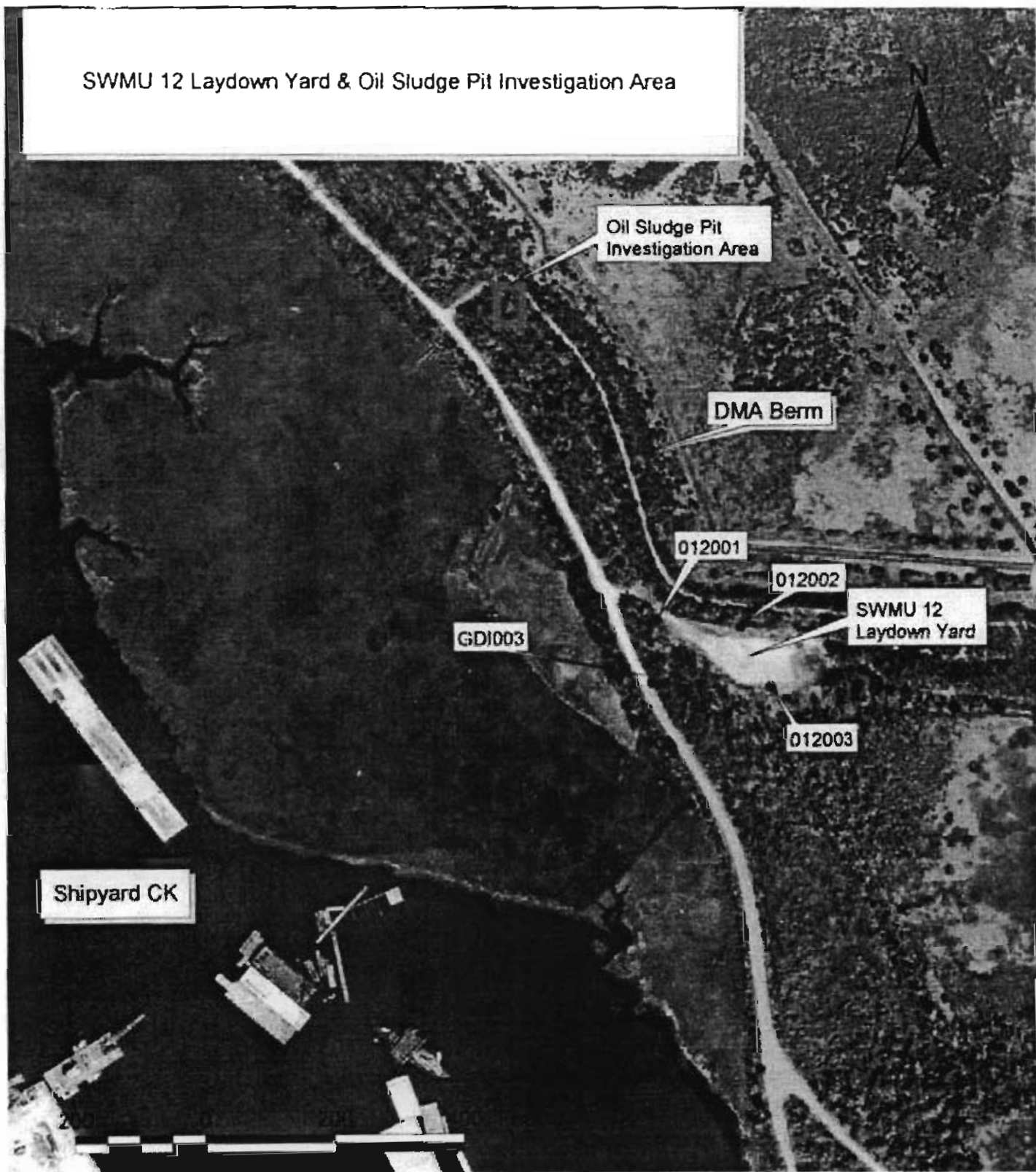
Leader: Todd Haverkost

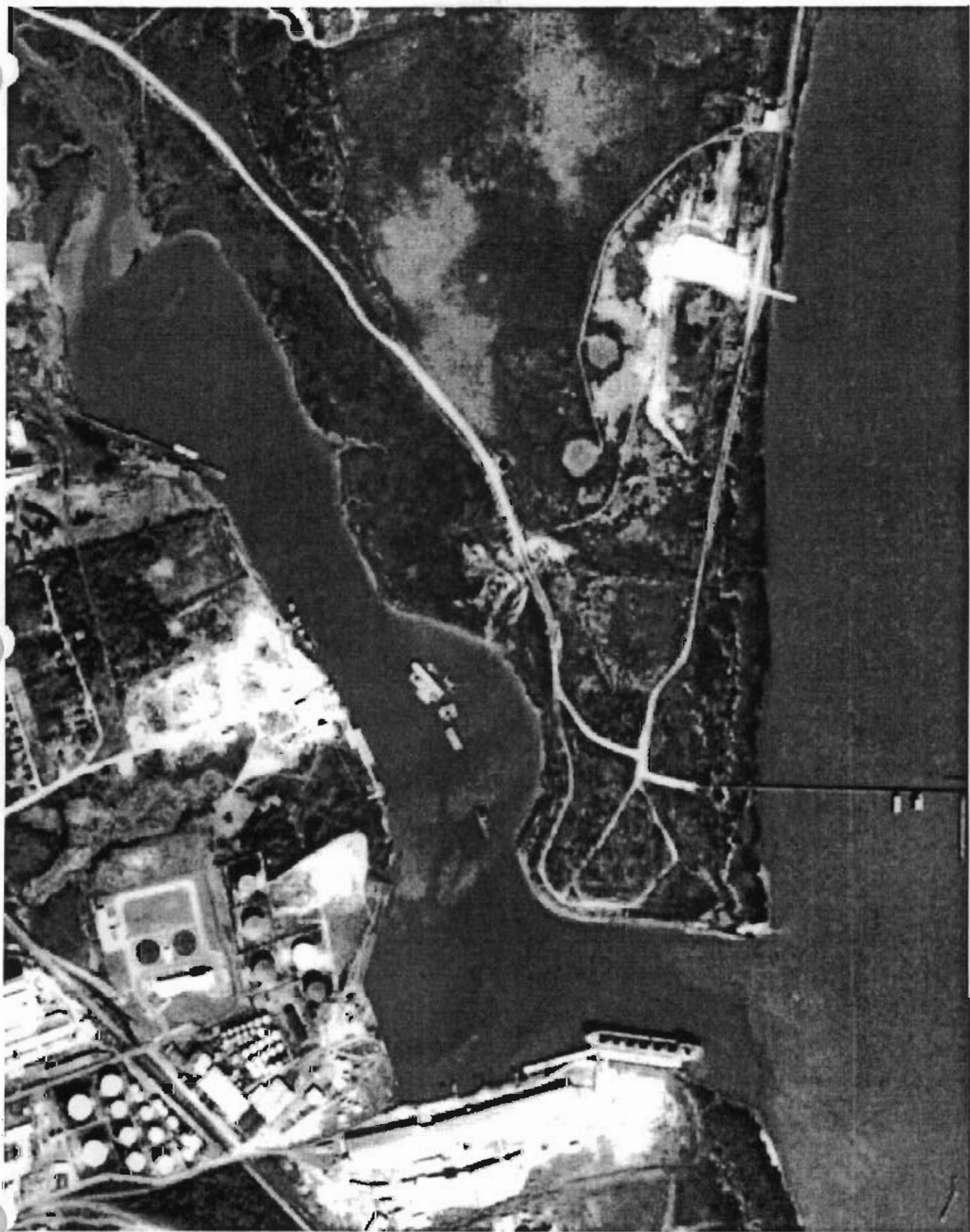
Scribe: Larry Bowers

DISCUSSIONS/DECISIONS

9908-M448	Todd	<p>SWMU 12 Revisited</p> <ul style="list-style-type: none">∞ Handout provided.∞ An aerial photo that was provided to the PT showed the FF training area about 200 to 400 yards north of where it currently is thought to be.∞ EnSafe completed extensive hand augering in the "new" area and did NOT find any evidence of SWMU 12.∞ Note that G & Miller conducted similar sampling in the late 80's and could not find anything either.∞ This still does not explain the high arsenic GW hits in the former SWMU 12 area - the contractor lay down area.∞ Two action items were generated from this discussion (update SWMU 12 memo and contact Dr. M. regarding basewide inorganics). Refer to Action Item list in these minutes.
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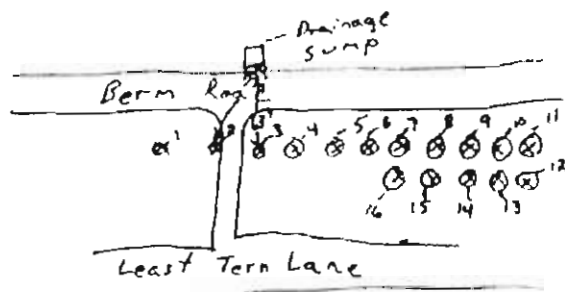
SWMU 12 Laydown Yard & Oil Sludge Pit Investigation Area





SWMU 012 5-17-99
O.I. sludge Pit

Dredged Materials Area



SWMU 012 5-18-99

Hand Auger Survey

crew - S. Watson

T. Temple

Wx - clear 70°F

Activity - Exploratory Hand Augering
to 4'

Hand Auger #1

0'-2.5' - Brown sandy clay

2.5'-4.0' - Gray sandy clay w/shells

Hand Auger #2

0'-4.0' Brown silty clay

Hand Auger #3

0'-1.5' Brown silty sand

1.5'-2.5' Brown sandy clay

2.5'-4.0' Brown silty clay

Hand Auger #4

0'-4' Tight brown clay

Hand Auger #5

0'-2.5' Tight brown clay

2.5'-4.0' orange/tan silty clay

SWMU 012 5-18-99

Hand Auger #6

0'-2' - Tight brown clay
2'-4.0' - Reddish/Brown clay

Hand Auger #7

0'-2' Tight Brown clay
2'-4' Reddish Brown Clay

Hand Auger #8

0'-2' Tight Brown Clay
2'-4' Reddish Brown Clay

Hand Auger #9

0'-2' - Tight Brown Clay
2'-4' - Reddish Brown Clay

Hand Auger #10

0'-2' - ~~FT~~ST Tight Brown clay
2'-4' - Reddish Brown clay

Hand Auger #11

0'-2.5' Tight Brown clay
2.5'-4' - Reddish Brown Clay

Hand Auger #12

0'-2' - Tight Brown clay
2'-4' - orange/tan clay

Hand Auger #13

0'-1.5' - Brown sand w/slag (metallic)
1.5'-4' - Orange/brown clay

Hand Auger #14

0'-2' - Brown sand w/slag
2'-4' - orange/brown clay

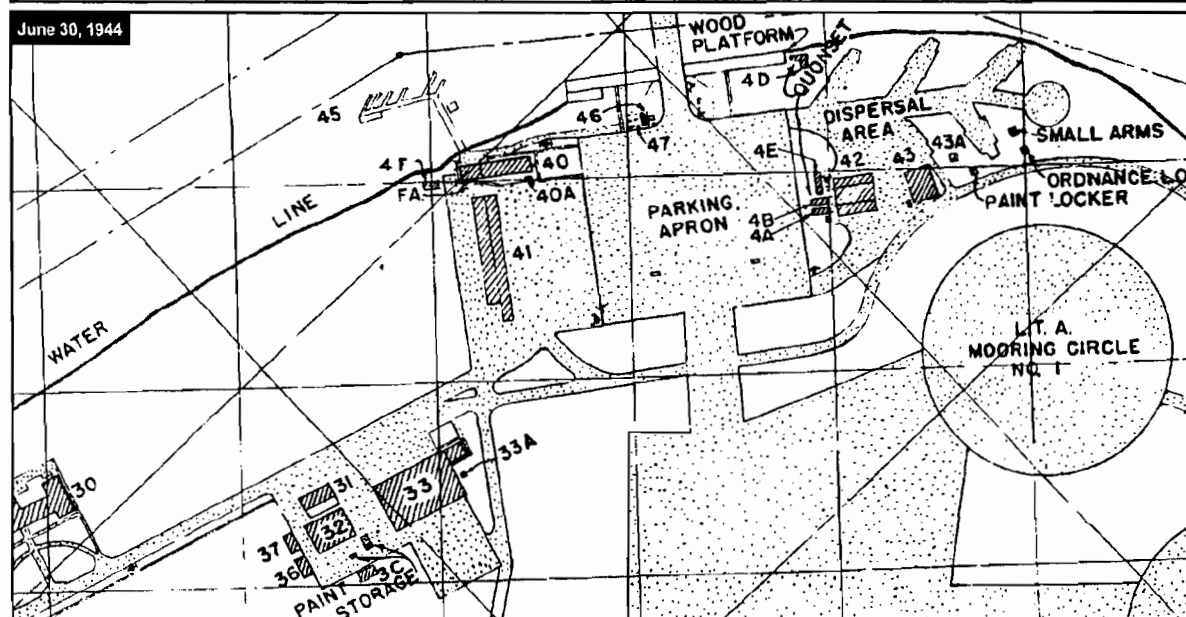
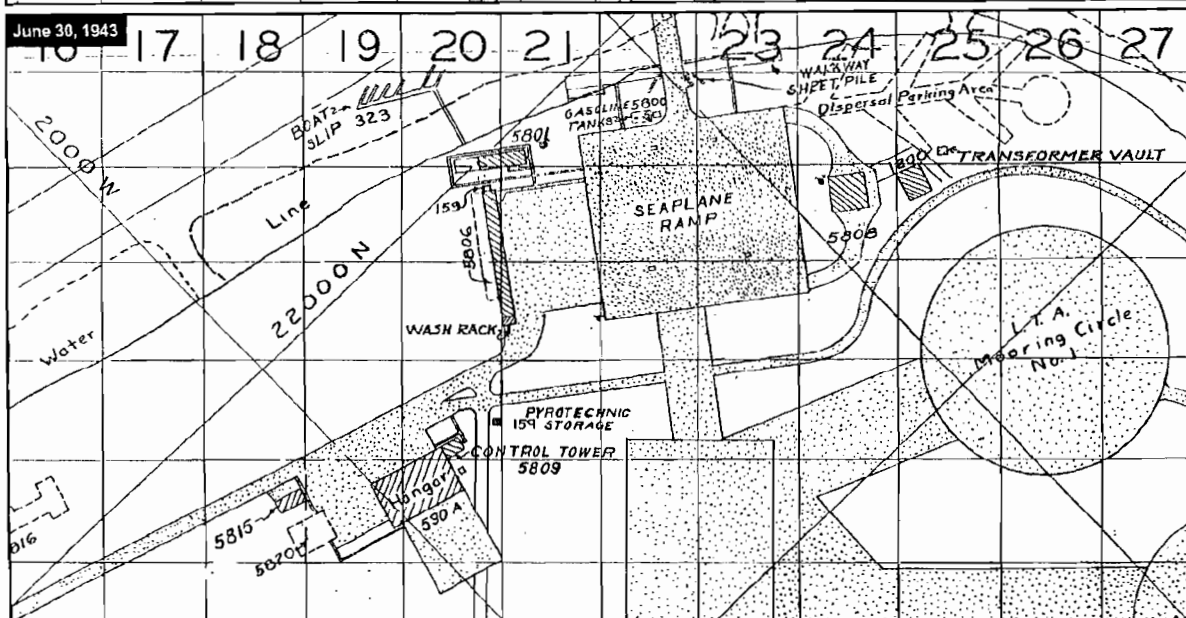
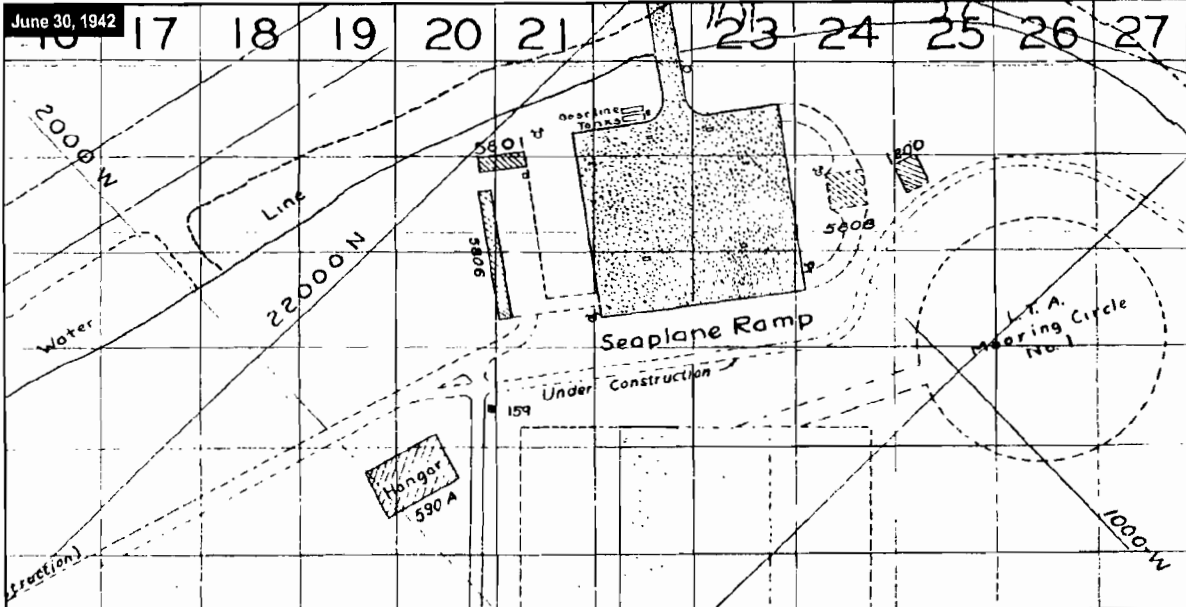
Hand Auger #15

0'-2' - Tight brown clay
2'-4' - Brown/orange clay

Hand Auger #16

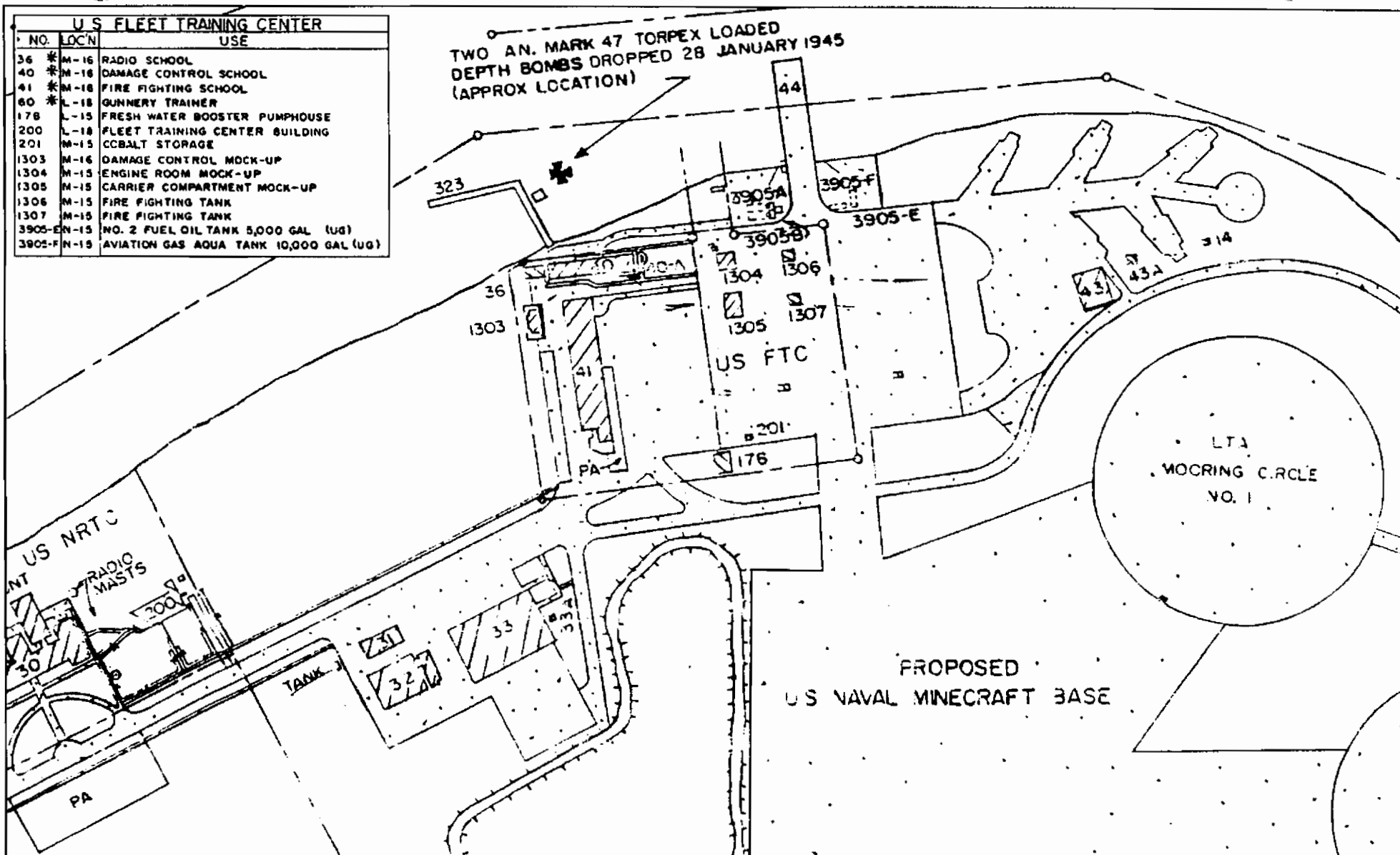
0'-2' - Tight Brown clay
2'-4' - Brown orange clay

Appendix B



APPROXIMATE SCALE 1 inch = 225 Feet

Figure 1
AOC 679 Historical Record
Zone I RFI Report Addendum
Charleston Naval Complex Annex - Zone I



Appendix C



DEPARTMENT OF THE NAVY
SUPERVISOR OF SHIPBUILDING, CONVERSION AND REPAIR, USN
PORTSMOUTH, VIRGINIA, ENVIRONMENTAL DETACHMENT CHARLESTON
1899 NORTH HOBSON AVENUE, BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405-2106

IN REPLY REFER TO:

Ser: 918

OCT 27 1998

From: Director, Supervisor of Shipbuilding, Conversion and Repair, USN, Portsmouth, Va.
Environmental Detachment Charleston, SC (SPORTENVDETHASN)
To: Southern Division Naval Facilities Engineering Command
(Code 18 - Hayes Patterson)

Subj: UNDERGROUND TANK INVESTIGATION AT BUILDINGS NS-1 & NS-26

Ref: (a) SOUTHNAVFACENGCOM Ltr. 5090, Ser: Code 18B4 dtd 10 August 1998,
Authorization for Tank Investigations NS-1 & NS-26, Project Number C98065

Encl: (1) Tank Search Investigation

1. The Environmental Detachment, Charleston was requested by reference (a) to perform an investigation to determine if underground storage tanks exist in the area of Buildings NS-1 and NS-26. The USTs are thought to be associated with an old seaplane landing and fueling site. The Statement of Work included with reference (a) detailed the expected steps for the investigation and provided a format for reporting the results of the Detachment's findings. The investigation concludes that there are no USTs in the area searched, results of the investigation and search are provided in enclosure (1).

2. This completes the required action for SPORTENVDETHASN with respect to the referenced project. Any questions should be addressed to R. A. Albers, Environmental Detachment, Charleston Business Manager at 743-6777, ext. 134 or Jack Amey, at ext. 227.

Respectfully,


E. R. Dearhart

Copy to:
File
Heather Hinds

2. EXECUTION

2.1 Actions Performed

The DET was tasked by SOUTHDIIV to perform a Geophysical Survey to determine if the underground tanks were still in place or had been previously removed.

Actions performed are listed below:

- The DET performed a historical records search of public works drawings and interviewed personnel to determine the tank locations.
- The DET performed a visual site inspection of each area to determine if any fill pipes, vent pipes or other surface structures/disturbances were present which may have indicated the presence of Underground Storage Tanks.
- A geophysical survey was performed to identify any underground metallic anomalies present in either area. Any structures, which may have caused an erroneous response from the EM61, were noted in the log book for later use in data analysis.
- Data was downloaded into an analysis program and studied to determine if any magnetic anomalies with characteristics of an underground tank were present.

3. CONCLUSION

3.1 Building NS-26

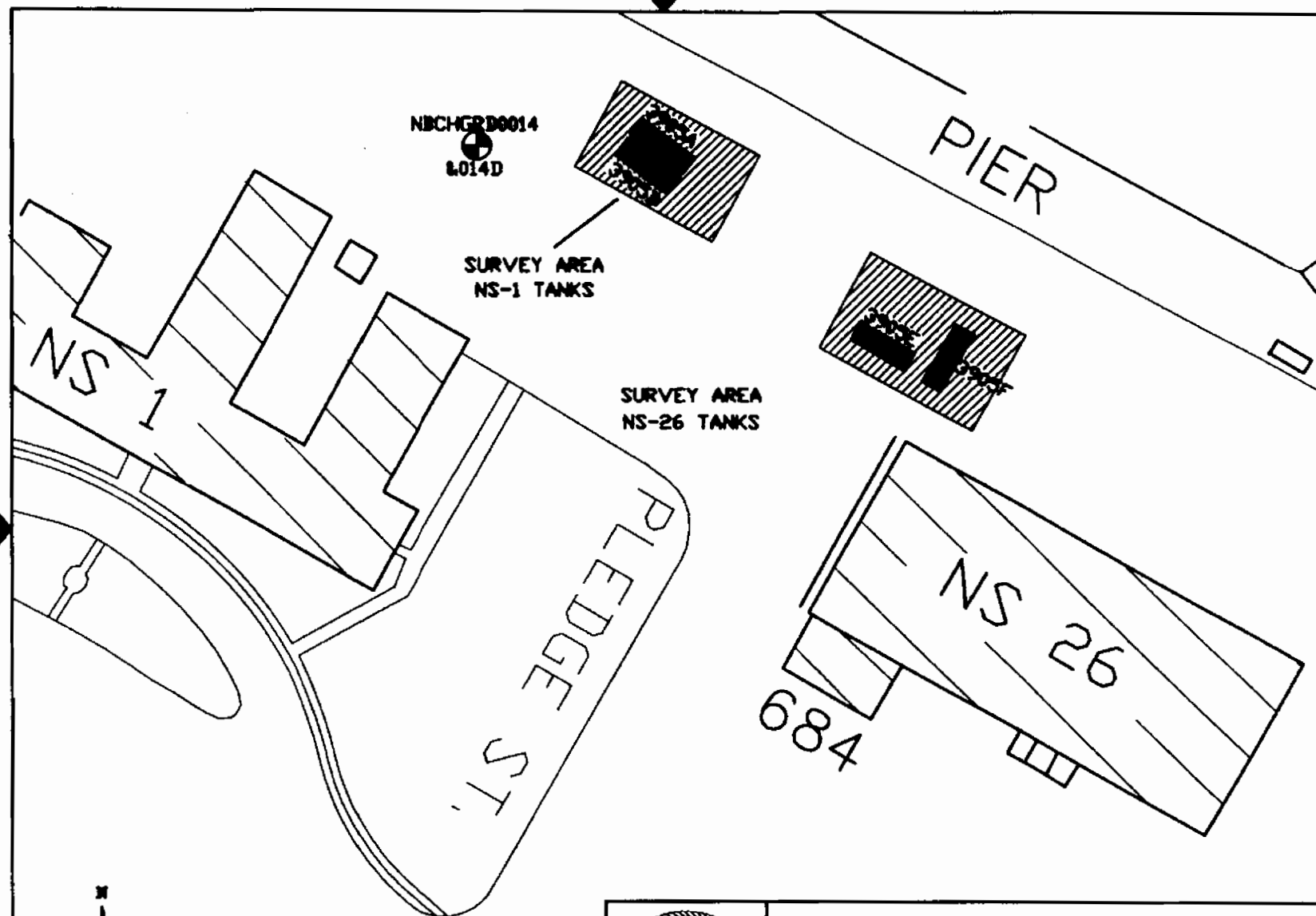
A thorough visual inspection of the areas surrounding the facility was performed. No surface structures were noted which would have suggested the presence of a UST. (See Figure 1).

An EM61 survey was performed of the area and no metallic anomalies with the characteristics of a UST were detected. (See attached profile).

Based on the information obtained during field investigation and subsequent data review, there does not appear to be a UST present at this location.

3.2 Building NS-1

A thorough visual inspection of the areas surrounding the facility was performed. One area of asphalt appeared to have been patched and was sunken in, giving the appearance of disturbed subsurface material. No surface structures were noted which would have suggested the presence of a UST. (See Figure 1).



TANK SEARCH SITE MAP
FORMER NAVAL BASE CHARLESTON
BUILDINGS NS-26 & NS-1

10-27-00

FIGURE 1

DRAWN BY: HEATHER HINDS

Danielson 21



J.A. JONES
ENVIRONMENTAL
SERVICES

Charleston Naval Complex
1849 Avenue F
North Charleston, SC 29405

Phone (843) 740-2780
Fax (843) 740-2785

FAX *Kris Garcia*

To: *Chris Garcia*

From: *Brian Campbell*

Fax #: *704 604 9996*

Total Pages: *12*

Phone #: _____

Date: *3/2/01*

Re: _____

☐ Urgent



☒ For Review

☐ Please Comment

☐ Please Reply

Comments:

South Carolina Department of Health and Environmental Control (S.C.D.H.E.C.)
Underground Storage Tank (UST) Assessment Report

Date Received

State Use Only

Submit Completed Form to:
UST Regulatory Section
SCDHEC
2600 Bull Street
Columbia, South Carolina 29201
Telephone (803) 734-5331

I. OWNERSHIP OF UST(S)

Agency/Owner: Southern Division, Naval Facilities Engineering Command, Caretaker Site Office

Mailing Address: P.O. Box 190010

City: N. Charleston State: SC Zip Code: 29419-9010

Area Code: 803 Telephone Number: 743-9985 Contact Person: LCDR Paul Rose

II. SITE IDENTIFICATION AND LOCATION

Site I.D. #: Unregulated

Facility Name: Charleston Naval Base Complex, Building NS 26

Street Address: Thompson Avenue

City: North Charleston, 29405-2413 County: Charleston

III. CLOSURE INFORMATION

Closure Started: 15 Dec 1996

Closure Completed: 8 Jan 1997

Number of USTs Closed: 1

N/A

Consultant

SPORTENVDETHASN

UST Removal Contractor

IV. CERTIFICATION (Read and Sign after completing entire submittal)

I certify that I have personally examined and am familiar with the information submitted in this and all attached documents and that based on my inquiry of those individuals responsible for obtaining the information, I believe that the submitted information is true, accurate and complete.

LCDR Paul Rose

Name (Type or Print)

Signature

V. UST INFORMATION

- A. Product.....
- B. Capacity.....
- C. Age.....
- D. Construction Material.....
- E. Month/Year of Last Use.....
- F. Depth (ft.) To Base of Tank.....
- G. Spill Prevention Equipment Y/N.....
- H. Overfill Prevention Equipment Y/N.....
- I. Method of Closure Removed/Filled.....
- J. Visible Corrosion or Pitting Y/N.....
- K. Visible Holes Y/N.....

	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6
Waste oil						
200 gal.						
> 30 yrs.						
Steel						
Unk.						
5.5'						
N						
N						
R						
Y						
N						

- L. Method of disposal for any USTs removed from the ground (attach disposal manifests)

UST NS 26 was removed, drained, cut open at both ends, and cleaned with a steam cleaner. It was then cut up for recycling as scrap metal. (See Attachment III.)

- M. Method of disposal for any liquid petroleum, sludges, or waste waters removed from the USTs (attach disposal manifests)

The residual fuel oil, waste water, and sludge were recycled.

- N. If any corrosion, pitting, or holes were observed, describe the location and extent for each UST

UST NS26 was severely corroded and pitted, but no holes were found.

VI. PIPING INFORMATION

- A. Construction Material.....
- B. Distance from UST to Dispenser.....
- C. Number of Dispensers.....
- D. Type of System P/S.....
- E. Was Piping Removed from the Ground? Y/N....
- F. Visible Corrosion or Pitting Y/N.....
- G. Visible Holes Y/N.....
- H. Age.....

Note 1: UST NS26 was a gravity fed waste oil tank for Building 26

Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6
Steel					
3'					
1 See note 1					
See note 1					
Y					
Y					
N					
> 30 yrs					

- I. If any corrosion, pitting, or holes were observed, describe the location and extent for each line.

All piping associated with the tank was pitted and corroded, but no holes were found.

VII. BRIEF SITE DESCRIPTION AND HISTORY

Building NS 26 was part of the Navy's Shore Intermediate Activity (SIMA) complex. The building was built in 1958 and renovated in 1985. Although an oil/water separator is referenced in early building plans, no separator could be located at the time of the tank removal. It is assumed that the oil water separator piping has not been used since the 1985 renovation. The tank apparently continued to be used by pouring used oil down the six inch pump-out pipe.

After sample results were reviewed, efforts were made to "chase" (remove) contaminated soil at the site. The northwest end of the excavation was extended in an effort to recover petroleum contaminated soil. As digging proceeded, OVA readings were taken using the Micro FID flame ionization detector to determine how far to proceed. The OVA reading at the end of the original excavation was 558 parts per million (ppm). The excavation was extended approximately 7 feet out and 8 feet below ground surface level. OVA readings did not improve. The last OVA reading, taken along with soil sample SPORT 0319-1, registered 3005 ppm. Since no improvement was noted based on OVA readings and the excavation was about to impact sewer piping, digging was discontinued.

VIII. SITE CONDITIONS

	Yes	No	Unk
<p>A. Were any petroleum-stained or contaminated soils found in the UST excavation, soil borings, trenches, or monitoring wells?</p> <p>If yes, indicate depth and location on the site map. [UST excavation]</p>	X		
<p>B. Were any petroleum odors detected in the excavation, soil borings, trenches, or monitoring wells?</p> <p>If yes, indicate location on site map and describe the odor (strong, mild, etc.) [strong, UST excavation]</p>	X		
<p>C. Was water present in the UST excavation, soil borings, or trenches? If yes, how far below land surface (indicate location and depth)? _____</p>		X	
<p>D. Did contaminated soils remain stockpiled on site after closure? If yes, indicate the stockpile location on the site map</p> <p>Name of DHEC representative authorizing soil removal: See note 2. _____</p>	X		
<p>E. Was a petroleum sheen or free product detected on any excavation or boring waters?</p> <p>If yes, indicate location and thickness on the site map.</p>		N/A	

Note 2: The tank and piping excavations were filled with clean dirt. The contaminated soil has been stockpiled for bioremediation or disposal. Per conversation with DHEC, Mr. Tim Mettlen, and SouthDiv, Mr. Gabriel Magwood, petroleum contaminated soil may be removed from the excavation and stockpiled for disposal or remediation.

LX. SAMPLE INFORMATION

S.C.D.H.E.C. Lab Certification Number 10120

[illegible]

* = Depth Below the Surrounding Land Surface

X. SAMPLING METHODOLOGY

Provide a detailed description of the methods used to collect and store (preserve) the samples.

After the removal of UST NS26 soil samples were taken. Sampling was performed in accordance with SC DHEC R.61-92 Part 280 and SC DHEC UST Assessment Guidelines.

The samples are identified as follows:

	Detachment Charleston		General Engineering Labs
Soil Sample	UST26-1	=	SPORT -0280-1
Soil Sample	UST26-2	=	SPORT -0280-2
Soil Sample	UST26-3	=	SPORT -0280-3
Soil Sample	UST26-4	=	SPORT -0280-4
Soil Sample	UST26-5	=	SPORT -0280-5
VOA Trip Blank	-----	=	SPORT -0280-6
Soil Sample	UST26-6	=	SPORT -0319-1
VOA Trip Blank	-----	=	SPORT -0319-2

Sample jars were prepared by the testing laboratory. The grab method was utilized to fill the sample containers leaving as little head space as possible and immediately capped. Soil samples were extracted at the tank ends. UST piping soil samples were taken under the piping at the mechanical connections.

The samples were marked, logged, and immediately placed in sample coolers packed with ice to maintain an approximate temperature of 4° C. Tools were thoroughly cleaned and decontaminated with organic-free soap and water after each sample.

The samples remained in the custody of SPORTENVDETCHASN until they were transferred to General Engineering Laboratories for analysis as documented in the attached Chain-of-Custody Record.

XI. RECEPTORS

Yes No

A.	<p>Are there any lakes, ponds, streams, or wetlands located within 1000 feet of the UST system?</p> <p style="text-align: center;">[Cooper River ~ 107']</p> <p>If yes, indicate type of receptor, distance, and direction on site map.</p>	X	
B.	<p>Are there any public, private, or irrigation water supply wells within 1000 feet of the UST system?</p> <p>If yes, indicate type of well, distance, and direction on site map.</p>		X
C.	<p>Are there any underground structures (e.g., basements) located within 100 feet of the UST system?</p> <p>If yes, indicate the type of structure, distance, and direction on site map.</p>		X
D.	<p>Are there any underground utilities (e.g., telephone, electricity, gas, water, sewer, storm drain) located within 100 feet of the UST system that could potentially come in contact with the contamination?</p> <p style="text-align: center;">[sewer, steam line]</p> <p>If yes, indicate the type of utility, distance, and direction on the site map.</p>	X	
E.	<p>Has contaminated soil been identified at a depth of less than 3 feet below land surface in an area that is not capped by asphalt or concrete?</p> <p>If yes, indicate the area of contaminated soil on the site map.</p>		X

Attachment I

SITE MAP

You must supply a scaled site map. It should include all buildings, road names, utilities, tank and pump island locations, sample locations, extent of excavation, and any other pertinent information.

Site Maps 1, 2, and 3
Photographs 1 and 2

NS 26

Cooper River

Former NS 200
near known as
CSC Building 2

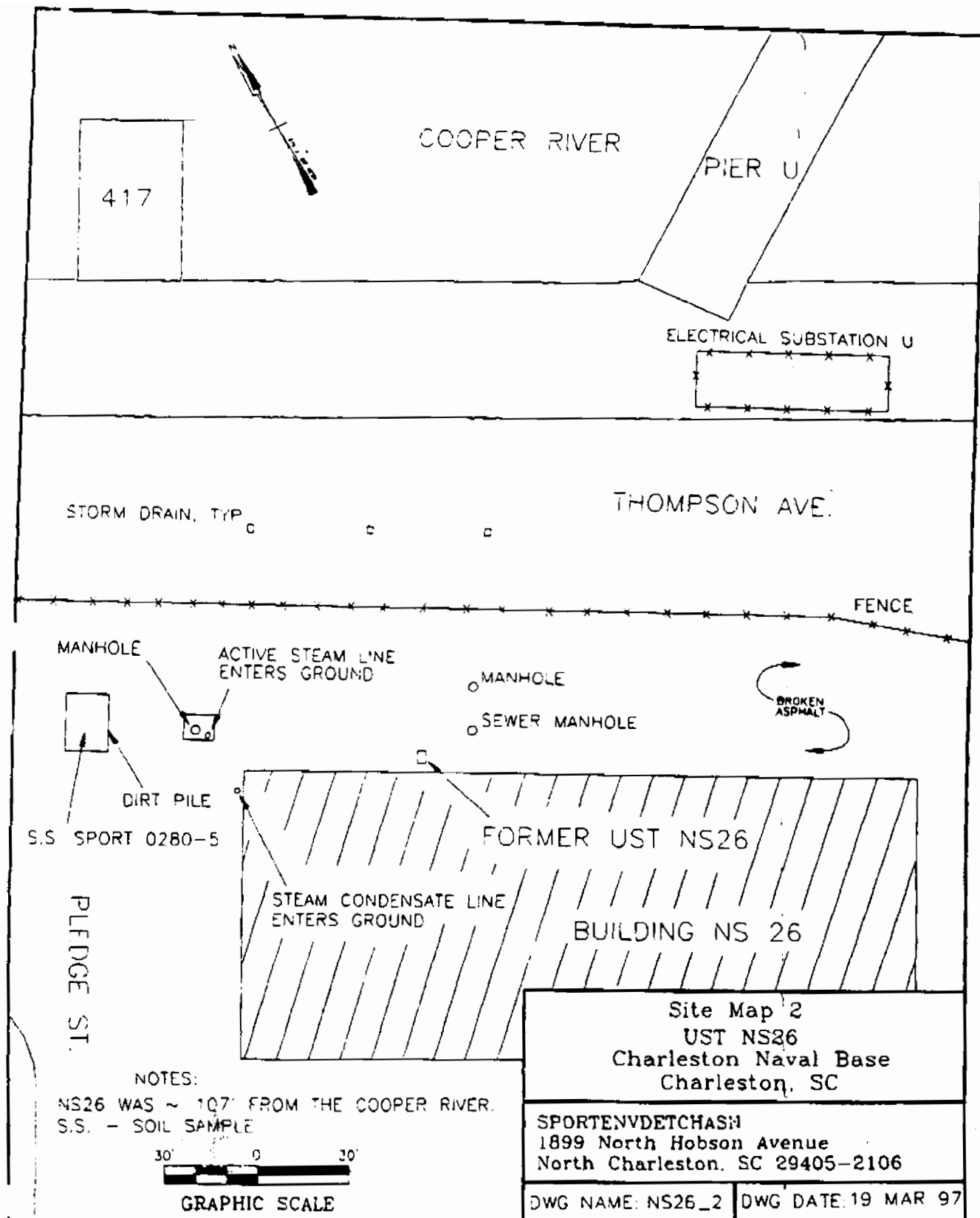
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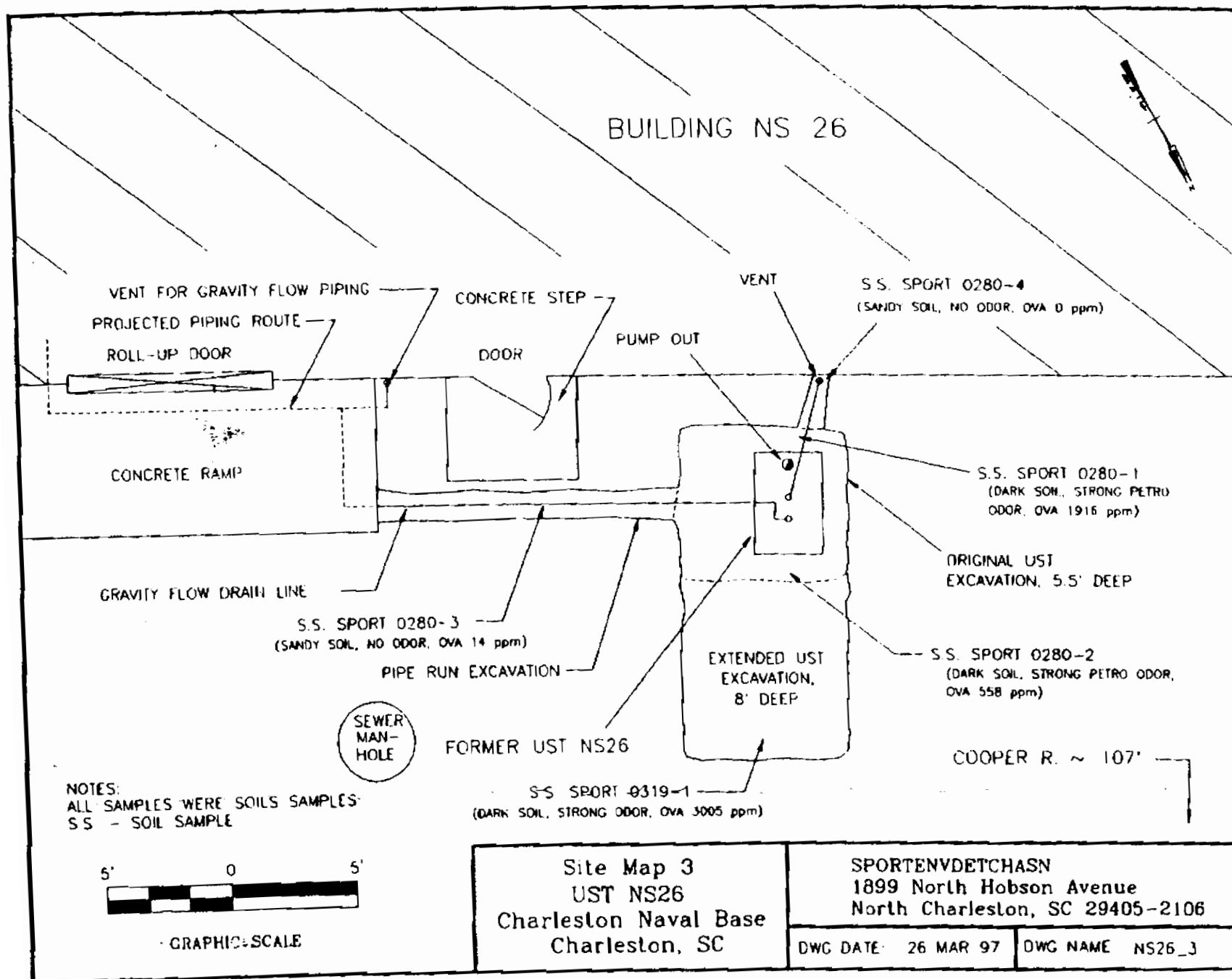
GRAPHIC SCALE

Site Map 1
UST NS26
Charleston Naval Base
Charleston, SC

SPORTENVDETHASN
1899 North Hobson Avenue
North Charleston, SC 29405-2106

DWG NAME: NS26_1 DWG DATE: 19 MAR 97







2600 Bull Street
Columbia, SC 29201-1708

COMMISSIONER:
Douglas E. Bryant

BOARD:
John H. Burris
Chairman

William M. Hall, Jr., MD
Vice Chairman

Roger Leake, Jr.
Secretary

Mark B. Kent

Cyndi C. Mosteller

Brian K. Smith

Rodney L. Grady

Mr. Gabriel L. Magwood
Southern Division NFEC
P.O. Box 190010
2155 Eagle Drive
North Charleston, South Carolina 29419-9010

Reference:

Underground Storage Tank Assessment Report dated September 3, 1997
Building 681 (UST 681-1 and UST 681-2) (Site Identification # 00967)
Charleston Naval Complex/Charleston Naval Base
Charleston, SC
Charleston County

Date:
November 12, 1997

Dear Mr. Magwood:

The author has completed technical review of the referenced document. As submitted, the report provides a narrative describing closure activities, site conditions and analytical results of environmental sampling conducted to determine if releases have occurred from operation of the referenced vessels and/or associated piping systems. The results presented indicate detectable levels of VOC (aromatic volatile organic compounds) were detected in groundwater grab sample(s) obtained from the tank pit excavation for UST 681-1. These results are below levels proposed in the SCAP (Soil Corrective Action Plan amended July 30, 1997) for the Charleston Naval Complex and below the MCL's (maximum contaminant levels) applied to class GB groundwaters. For this system, these results would appear to indicate that no additional endeavors for remedial actions and contaminant characterization are warranted at this time.

With regard to UST 681-2, the results presented indicate detectable levels of VOC and PAH (polynuclear aromatic hydrocarbon compounds) were detected in groundwater grab sample obtained from the tank pit excavation. Concentrations for the seven (7) PAH recognized as probable human carcinogens (Group B2) exceed the proposed interim drinking water standard of two microgram per liter (2.0 µg/l) sum total for these compounds and twenty-five micrograms per liter (25 µg/l) sum total for remaining PAH compounds. Soil samples SPORT0267-5 (tank pit excavation), 0274-1 and 0247-5 (piping run excavation) utilized elevated detection limits due to matrix interference. As identified in previous correspondence (Bristol to Arney, September 2, 1997), when detection limits are elevated and CoC's (contaminants of concern) are reported as zero (0) or BDL (below detection limits) it will be assumed that the chemical constituent is equal to the elevated detection limit. Further, soil sample SPORT0274-5 reported concentrations of naphthalene which exceed levels proposed in the SCAP (Soil Corrective Action Plan, amended July 30, 1997) for the Charleston Naval Complex. With consideration to the above, it appears that

77064983

Charleston Naval Base
Building 681 (#00967)
November 12, 1997
page 2

additional endeavors for remedial measures and contaminant characterization are warranted at this site. Additional assessment/corrective action activities proposed in the Tank Management Plan (dated October 18, 1996) should be implemented in an appropriate and timely manner. Employed activities should be technically sufficient and reasonable to determine the extent and severity (including horizontal and vertical delineation) of suspected contamination. Please be reminded that groundwater sampling (if necessary) will require construction of sampling points and will need to be submitted for prior review and approval, as appropriate.

Should you have any questions, please contact me at (803) 734-5328.

Sincerely,



Paul L. Bristol, Hydrogeologist
Groundwater Quality Section
Bureau of Water

cc: Trident District EQC

TABLE 1 (Page 1 of 2)
TANK DATA SHEET

TANK INFORMATION:

TGI Number USTNS036LO Work Package Number 148
Tank Number 681-2 Tank Serial Number N/A
Tank Description BOILER FUEL TANK Tank Location Bldg. 681 Location SOUTH Side
Contents in Tank/Type of Liquid: FUEL OIL
Height of Contents in Tank _____ Amount of Contents in Tank [GALS] _____
10' x 32' = 20,000 GALLON CAPACITY
Liquid Sample Number (copy attached) _____ Date Liquid Sampled _____
Approximate Amount of Sludge in Tank _____
Sludge Sample Number (copy attached) _____ Date Sludge Sampled _____

TANK CONTENTS DISPOSITIONING DETERMINATION:

_____ Liquid is "on-specification" waste oil. (See paragraph 4.1.3.2). Shop NA (E) point.
_____ Liquid is "off-specification" waste oil suitable for mixing with other "on-spec" waste oil
_____ Liquid is "off-specification" waste oil and must be handled as hazardous waste.

Liquid Dispositioned to: _____

(S) _____ Pay No. _____ Date: _____

(E) _____ Pay No. _____ Date: _____

_____ Sludge is non-hazardous solid waste.

_____ Sludge is characteristic hazardous waste.

Sludge Dispositioned for Disposal to: _____

(S) _____ Pay No. _____ Date: _____

(E) _____ Pay No. _____ Date: _____

T. R. 681-2

Tank and piping details ^{are} shown on public works drawing NS 681-120. Tank is used to store fuel for boilers in building 681 and 680, therefore supply/return lines must be blanked in both buildings to isolate tank. Tank is located just outside of the boiler room of building 681. The tank has a capacity of 20,000 gallons.

J. J. [Signature]
75-27569